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Report of a Visit to American Educational Institutions

BY

E. S. A. ROBSON, M.Sc.

Associate of the University of Manchester;
Principal of the Warrington Secondary School and Technical Institute;
late Lecturer in Mathematics and Physics in the Royal Technical Institute, Salford

SHERRATT & HUGHES
65 Long Acre, London
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PREFACE.

The account of American education described in these pages is the amplification of a report presented to the Salford Education Committee in April, 1904. At the time of the visit of the Moseley Education Commission to the United States in November, 1903, the writer was granted leave of absence to make an independent inquiry among the larger American cities and to collect information concerning elementary and higher education which might prove useful in suggesting ideas for the further development of a municipal educational scheme. With this object in view about two months were spent in America, the first portion being occupied in New York, where a general idea of the different types of schools and colleges was obtained, besides gaining information about the places of educational interest in other cities. On leaving New York the writer travelled northwards through Hartford, New Haven (Yale University), and Worcester, to Boston (for Harvard University and the Massachusetts Institute of Technology). Turning southwards the route lay through Philadelphia, Baltimore and Washington, where a visit was paid to President Roosevelt and to the U.S. Chief Commissioner of Education. From Washington the writer struck out westwards to Pittsburg, Chicago, and Michigan, returning to New York *via* Niagara Falls. Altogether a distance of 3,000 miles was covered, and visits paid to 38 institutions for elementary, secondary and higher education. Opportunities were taken to interview heads of business and engineering firms with regard to the employment of trained workpeople. To the original report, which was chiefly concerned with secondary and technical education has been added a description of the American Universities and Colleges, in each case giving a short

historical account of their growth. The detailed information which it has been possible to present is largely due to the courtesy and kindness of Dr. W. T. Harris, the Chief Commissioner of Education, who has placed at the disposal of the writer a series of valuable monographs on educational topics. The writer begs also to acknowledge his indebtedness to the teachers and officials in the various institutions described; to Dr. F. C. Rose, His Majesty's Consul at Stuttgart, for information connected with German technical education; and to the Salford Education Committee for their kind reception of the original report.

E. S. A. R.

October, 1904.

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"Report of a Visit to American Educational Institutions."

General Remarks on the American System of Public Education.

In order to understand the complexity of the American school system it must be remembered that each State has its own educational laws, and raises, appropriates and distributes school funds in its own way. There is no national Board of Education, but at Washington there is a Department known as the Bureau of Education, which simply collects and publishes statistics but which cannot impose regulations on any State. Every large city has its own Board of Education which may be elected:—

(1) By the Mayor, as in New York, Chicago or Baltimore.

(2) By the Judges of Common Pleas, as in Philadelphia.

(3) Directly by the people, as in Boston, Pittsburg and St. Louis.

Estimates are drawn up by this Board and submitted to the City Council, which appropriates the sum required. Each State is sub-divided into counties which also levy a separate rate in order to level up the different cities within its borders. The education rate may thus consist of three parts, drawn from the city, county and state respectively. The chief officer of the Board of Education is the superintendent or Director, who has very extensive powers, including the examination and appointment of teachers.

With regard to teachers the regulations and qualifications vary in different cities, *e.g.*, the Board examines and appoints its teachers in Washington, Chicago, Philadelphia, and Boston, while in Baltimore, St. Louis and New York the teachers are

recommended by the superintendent and the appointment confirmed by the Board.

The term "public education" includes:—

(1) Kindergarten Schools (under 6 years of age).

(2) Primary Schools (6—10).

(3) Grammar Schools (10—14).

(4) High Schools (14—18).

The primary and grammar "grades" are often in the same building, and correspond to the "standards" of an English elementary school. All education in public schools is free, so that the American child may be educated up to the age of 18 without any payment whatever. The term "private school" includes: (1) Schools maintained for private profit; (2) voluntary schools maintained by religious bodies of various religious denominations, but chiefly Roman Catholics. Such voluntary schools receive no help whatever from the rates. Technical Institutes are not, as a rule, under the direction of the City Board of Education, but are either supported by the State or under private control. The same remark applies also to the Universities.

With regard to the educational buildings the attention of the visitor is at once drawn to the elaborate nature of their equipment.

In the larger cities the public schools are fine handsome buildings of four or five storeys in height, fitted with modern improvements, including dual desks, heated cloak rooms, gymnasia and shower baths. Some of the latest type are H-shaped to allow plenty of light on all sides; all buildings are heated by steam pipes and radiators usually on the "Plenum" system, but the temperature is often unpleasantly high (nearly 75°F.) and would appear to have an enervating effect on the pupils. In some schools the whole of each floor is divided into class rooms by means of sliding panels, which have blackboards let into the woodwork.

The most noticeable features in the class rooms are the decorations of flags, plants, and beautiful casts or drawings; the "dado" of blackboard which occupies the wall space in each room is used by the pupils as an alternative to writing in

their own books. The teachers find it most useful in pointing out mistakes which, on the blackboard, are magnified by the pupils and consequently easily brought to notice.*

In most American cities the School Session lasts from 9 to 12 in the morning, and from 1 to 3 in the afternoon. Owing, however, to a lack of accommodation in some of the larger cities a system of part-time instruction has been introduced into the kindergarten and primary classes. By this arrangement one batch of pupils attend from (say) 8-30 to 12-15, and a fresh batch from 12-30 to 4-15. This is obviously unsatisfactory, both for the teacher and the children as the afternoon section come to school tired, and are disinclined for mental work.

As a rule public schools commence their term in September and end in June, having a long summer holiday, together with certain State and religious holidays such as Christmas, Easter, Whit-week, Washington's Birthday, Independence Day, Thanksgiving Day, &c.

In New York the idea of instituting holiday playgrounds has been carried out very successfully. Nature exhibits are held in the spring and autumn, gifts of fruit and flowers being sent by benevolent citizens for distribution among the poor children, whose parents are also invited. The Ladies' Public School Association is doing remarkably good work in this direction, visiting schools and paying particular attention to the kindergarten work. School decoration is encouraged, pictures and charts are distributed to the various schools, and a supply of nature study material is sent to the different teachers. A critical report of such visits is drawn up and forwarded to the City Superintendent of Education and the keen interest aroused in the parents by this means augurs well for the future of American education.

In visiting the elementary schools of America nothing strikes the visitor so much as the apparent simplicity of the discipline, contrasting as it does somewhat favourably with

* It is rather curious that this idea, which appears novel to American teachers, originated in the old Lancasterian type of school in England, and may yet be seen in some old school buildings.

the heavier military discipline of European schools. In many cities restrictions are placed on all teachers (including head teachers) against the use of corporal punishment, and they are even forbidden to make the pupil stand up for lengthy periods. Pupils can be detained after school hours, however, for a period not exceeding half an hour. The habits of self-control and the incentives to progress put forward by the teachers appear to bring beneficial results similar to those obtained in some of our English secondary schools, and which might be imitated with more elementary pupils. It is noticeable that in the States the difference in the methods used in primary and secondary education is extremely slight, and educational progress is facilitated by the close union of the two types of school.

As the public schools are all secular, no religious teaching is carried out, but in the opening morning service there is a short period of Bible reading, followed by national songs and poetry, finishing sometimes with the salute of the national flag, the latter being probably explained by the large number of foreign-born children, who would become a distinct menace to the State were they not early imbued with the national spirit of their adopted country.

An extreme fastidiousness with regard to personal cleanliness is evident on all sides, *e.g.*, by the provision of envelopes for each child's drawing utensils, and by the periodic inspection of pupils by qualified medical men. In some schools a certain room is furnished as a small dispensary, and any child found suffering from incipient colds or slight ailments receives prompt treatment by a visiting physician.

The efficiency of the teaching is increased by the generous provision of room decorations of herbaria, terraria and collections of butterflies and eggs. As previously mentioned, pictures or statuary adorn the walls. In teaching geography use is made of maps supplied by the railroad companies or by the United States geological, topographical, and census departments.

The course of study in the elementary schools is not unlike that in corresponding types of English schools, as may be seen from a glance at the curriculum for New York Elementary

Schools (Primary and Grammar Grades) for pupils ranging from 6 to 14 years of age.

Time Schedule on the Basis of 1,500 Minutes Per Week.

Adopted by the Board of Superintendents in June, 1903.

Years.	i.	ii.	iii.	iv.	v.	vi.	vii.	viii.
Opening Exercises	75	75	75	75	75	75	75	75
Physical Training, Physics and Hygiene, Recesses and Organized Games	200	165	165	165	90	90	90	90
English	450	510	450	375	375	375(9)	360(8)	320
Penmanship	100	125	125	75	75	75	—	—
Electives (German, French, Latin, Stenography)	—	—	—	—	—	—	—(4)	200
Geography	—	—	—	135	120	120(2)	80	—
History	—	—	—	—	90	120(3)	120(3)	120
Mathematics	120	150	150	150	150	200(4)	160(4)	160
Nature Study	90	90	90	90	75	—	—	—
Science	—	—	—	—	—	—(2)	80(2)	80
Drawing and Constructive Work	160	160	160	120	120	120(2)	80(2)	80
Shop Work, Cooking, or Advanced Sewing	—	—	—	—	—	—(2)	80(2)	80
Sewing and Constructive Work	60	60	60	60	60	60	—	—
Music	60	60	60	60	60	60	60	60
Study	—	—	90	135	150	150(5)	200(4)	160
Unassigned Time	185	105	75	60	60	55	75	75
	1500	1500	1500	1500	1500	1500	1500	1500

Note.—Both boys and girls are to take the work outlined under Sewing and Constructive Work in the first three years.

The figures in parentheses in the seventh and eighth years represent the number of forty-minute periods per week.

It may be as well to make a few remarks on this curriculum in order to elucidate some of the points involved.

(1) Electives (German, French, Latin, Stenography) are taken in the grades 7 and 8 as preparation for High School work.

(2) The study and unassigned time refers to the time spent on study or preparation of work for themselves, *e.g.*, modelling, &c., and constructive work.

(3) English includes spelling, grammar, composition, reading, penmanship, memorising, dictation. This subject is taught extremely well and the practice in speaking and memorising make the pupils very ready in answering questions. The cleverness in verbal description is probably superior to the written work.

(4) Ethical training is instilled into the pupil by reference to the spirit of the class room and the school, and by pointing out his relation to the family, neighbourhood, city, state and nation. Each child is helped towards self-direction and self-government and encouraged to a sense of honour so as to preserve order without surveillance. Forms of organisation after the style of the "school city" are designed to develop the sense of responsibility.

(5) Geography is taught by a kind of concentric system, *i.e.*, the study of the child's own city is extended and amplified into the study of the earth itself; the purchases in the shops are made to suggest the regions of their production, and the presence of foreign emigrants suggests the study of the different nations. Again, beginning with the question of climate, the pupil is led from the causes of physical conditions to a consideration of their influence in production, transportation, and exchange.

(6) The work in mathematics is similar to that taught in an English elementary school. As many pupils, owing to ill-health, change of residence, etc., fall behind in their work, reaching the 6th Grade at the late age of 14, and are compelled to leave, the work in this grade is made of a somewhat commercial character. At the beginning of the seventh year Algebra and Geometry replace Arithmetic; in Algebra no effort is made to present the formal science. The work in geometry is of a constructional character, and is purely inductive.

(7) Civics is brought into the study of history.

(8) The course in drawing seems somewhat novel when compared with the English methods. In the lower grades there

STATISTICS RELATING TO PUBLIC ELEMENTARY AND SECONDARY SCHOOLS IN VARIOUS CITIES (1900—1901).

		Pupils in Public Schools.			Teachers.		Schools.		Receipts.			Expenditure.				
City.	Population, 1900.	Day.	Evening.	Days School open.	Male.	Female.	Day.	Evening.	State appropriations or Taxes.	City appropriations or Taxes.	Total (including County Taxes, etc.)	Permanent Investments and lasting Improvements.	Teaching and Supervision.	Current and Incidental Expenses.	Evening Schools.	Total.
San Francisco	342,782	41,980	6,537	195	35 34	803 70	90	8	£142,592	£86,710	£240,513	£1,118	£181,286	£33,876	£14,245	£230,525
New Haven	108,027	17,636	1,205	200	25 34	419 4	48	6	—	84,801	[a] 84,801	7,154	57,447	19,380	1,027	85,208
Washington	278,718	47,431	3,311	176	164 67	1119 67	133	20	—	—	305,142	74,760	175,421	45,154	1,805	297,140
Chicago	1,698,575	262,738	8,253	190	359 172	5286 78	333	31	69,825	1,647,100	[b] 1,830,147	222,802	1,021,320	314,836	11,681	1,570,639
Baltimore	508,957	90,823	1,817	191	150 42	1526 17	104	10	50,000	175,200	226,100	—	294,126	43,172	572	247,870
Boston	560,892	91,796	11,997	194	239 231	1769 231	265	20	—	—	742,893	147,437	438,009	138,389	19,059	742,894
Worcester	118,421	22,522	1,560	200	53 41	501 43	71	19	—	106,000	[c] 108,772	27,610	75,416	25,342	4,041	132,139
Detroit	285,704	40,303	1,253	187	39 37	822 7	69	8	32,769	162,654	[d] 198,245	76,247	131,768	41,417	933	250,365
Minneapolis	202,718	37,552	—	182	10	777	60	0	26,284	124,405	[e] 153,344	13,184	118,010	36,625	—	167,819
St. Louis	575,238	79,274	3,438	193	52 19	1587 45	141	11	32,112	289,380	[f] 392,572	86,841	215,345	69,850	2,410	374,446
Newark	246,070	41,870	4,462	190	27 51	773 61	53	11	77,655	102,815	[g] 180,298	65,764	123,740	46,479	6,749	242,732
New York	3,437,202	559,918	65,521	191	906 541	9828 530	466	71	257,164	3,445,400	[h] 3,766,435	1,241,523	2,548,692	709,458	69,599	4,569,272
Cleveland	381,768	59,635	1,579	184	68 31	1174 5	69	36	30,871	297,579	[i] 379,376	112,356	197,974	74,973	1,489	386,792
Philadelphia	1,293,697	187,833	22,498	183	163 35	3289 675	325	84	—	888,442	[j] 888,442	215,313	501,309	205,510	13,739	935,871
Pittsburg	312,616	46,317	—	200	52 —	942 —	84	—	40,485	214,834	[k] 264,069	112,686	131,985	54,765	—	299,436
Providence	175,597	32,540	5,549	195	55 105	599 92	99	20	6,227	135,334	[l] 149,958	19,416	94,628	46,840	6,977	167,861
Milwaukee	285,315	41,712	—	196	64 —	772 —	80	0	21,985	101,400	[m] 147,622	5,400	124,196	22,506	—	152,102

NOTE.—Under the heading "Teachers" the lower rows of figures refer to evening schools.

Amount available for the year:

a. £85,233.
b. £2,167,890.
c. £132,665.
d. £251,763.
e. £168,337.
f. £429,742.
g. £246,819.
h. £7,696,878.
i. £633,173.
j. £1,021,201.
k. £417,605.
l. £186,575.
m. £258,549.

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is neither mechanical nor model drawing, but the children design coloured sketches in order to illustrate their lessons in history, geography or nature study, or even in the graphical method of arithmetical teaching. The study of pictures is encouraged and descriptive work under this head leads to good results; in every grade some constructive work, in cartridge paper, cardboard or oak "tag" is performed, with a view to elucidating the principles of design.

The writer has seen some interesting drawing work in the elementary schools of Lancashire which compares most favourably with American work with respect to executive ability, but which is lacking in originality and inventiveness.

(9) Nature study is still growing in popularity at a rapid rate in American schools. The presence in the schoolroom of birds in cages and of terraria, herbaria, aquaria, gives opportunities for the study of all kinds of life, while visits to parks and museums, and even school journeys, offer ample scope for interesting work. Stories, fables, and songs are studied with reference to the natural objects mentioned therein.

It may perhaps be interesting to conclude this introductory description of public education by quoting some figures from the Report of the Commissioner of Education (Dr. W. T. Harris) for 1901. The figures are for elementary and secondary education so that it is difficult to make any comparison with the corresponding figures for English schools.

TABLE I.

Common School Statistics of the United States, 1900–1901.

Total population	77,262,743
No. of pupils enrolled	15,603,451
Per cent of population	20·2
Per cent of daily attendance	68·5
Average length of school year	144·2 days.
Per cent of male teachers	28·8
Per cent of female teachers	71·2
Total expense per head of population	12s. 2d.
Total expenditure per pupil	£4 8s. 1d.
Average salary of male teachers	£119 1s. 3d.
Average salary of female teachers	£97 18s. 4d.
Age for free education	6—21.
Age for compulsory attendance	8—14.

STATISTICS RELATING

City.	Population, 1900.	Pupils in Public Schools. Day.	Evening
San Francisco	342,782	41,980	6,537
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Baltimore	508,957	90,823	1,817
Boston	560,892	91,796	11,997
Worcester	118,421	22,522	1,560
Detroit	285,704	40,303	1,255
Minneapolis	202,718	37,552	—
St. Louis	575,238	79,274	3,438
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Philadelphia	1,293,697	187,833	22,498
Pittsburg	312,616	46,317	—
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Milwaukee	285,315	41,712	—

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Age for free education	6—21.
Age for compulsory attendance	8—14.

Of the *income* the percentage of the total derived from: —

Income of permanent funds was	4·2%
State Taxes	16·4%
Local Taxes	68·6%
Other sources	10·8%
	100·0%

Including pupils in private institutions there were altogether 17,299,230 pupils in all kinds of educational institutes, of whom:

94·4%	were	under	Elementary	Instruction.
4·2%	,,	,,	Secondary	,,
1·4%	,,	,,	Higher	,,

Secondary Education

SECONDARY EDUCATION.

Under the term Secondary Education are included Public High Schools, Endowed Schools, and private venture schools.

The Public High Schools have a four years' course extending from 14 to 18 years of age, and they may be classified according to their curricula into:—

(1) The English High School, which offers no Greek but more or less Latin, together with a good course in modern languages.

(2) The Latin High School, which prepares for College, and which as a rule has no "election of studies."

(3) The Commercial High School, preparing for a business career.

(4) The Manual Training High School which pays particular attention to drawing, science, woodwork and machine tool work.

The Latin High School is common to the New England cities, which were among the first to start the public school system. Boston is said to have had a public school in the year 1634; Worcester started one in 1824, Providence in 1845, New York in 1849, Minneapolis in 1865. Of course, many schools offer facilities for specialising in several directions, *e.g.*, the Pittsburg High School has Academic, Normal and Commercial courses, while the Central High School, Philadelphia, confers degrees in seven different courses, viz., Classical, Latin, Scientific, Modern Languages, Commercial and Pædogogy.

Of the total number of scholars receiving secondary education in the United States about four-fifths are in public institutions and the remaining one-fifth in private institutions, the term "private" including: (1) denominational schools, and (2) schools started by private enterprise, such as the Pratt

Institute High School, Brooklyn, or the Dearborn Academy, Chicago. About 50 per cent. of private schools are unsectarian; a further 20 per cent. are controlled by the Roman Catholics, and the remainder belong to Baptists, Methodists and other denominations. Philadelphia contains the largest number of private schools, including the Girard College for Boys, Temple College, and the William Penn Charter School for Boys.

As is the case in Great Britain most of these private schools are not mixed schools, except occasionally in their preparatory departments; other secondary schools, such as the Packer Collegiate Institute of Brooklyn, are similar to an English "finishing" school for girls.

The private schools are said to have a slight advantage in having a free curriculum, and pay special attention to individual pupils, consequently about 19 per cent. of pupils in these schools are preparing for college, compared with 11 per cent. of pupils in public high schools.

The total number of students in public high schools, however, is on the increase—there being 541,730 pupils in these schools against 108,220 in private secondary institutions during the year 1901.

Duration of Course. With the exception of the Latin Schools which have a five years' course, starting at the age of 13, most of the high schools offer a four year course, the number who finish the course and "graduate," as it is termed, being about 12 per cent. (about 13·3 per cent. for girls and 10·5 per cent. for boys).

Of the students who "graduate" about one-third of the number enter college, the proportion of girls being much greater than that of boys (40 per cent. against 26 per cent.).

This difference is due partly to economic reasons and partly to the increased inducements offered to girls by the acquirement of a good college education.

To an observer familiar with the German or English secondary schools, the age of entrance, viz., 14 years, appears to offer ground for criticism, especially with regard to the teaching of classics and languages, and this probably explains

the small amount of work done in these subjects. This criticism does not apply to the study of science, as most teachers would be prepared to concede a four years' course as ample for the preparation of students entering college. A striking feature in American public high schools is the system of co-education which (contrary to foreign opinion) is quite a settled question and is simply a problem of adjustment. With respect to figures bearing on the question it may be mentioned that in the city of Providence the four high schools are all mixed; the same applies to Minneapolis and Pittsburg; in Chicago 14 out of 15 high schools have co-education; in Boston there are separate Latin Schools for boys and girls, but out of eleven schools six of them are mixed.

The city of Philadelphia has a scheme quite different from most other American cities, as its private schools are for both boys and girls, but, on the other hand, there is no co-education in the four public high schools. Another great dissimilarity between American and English secondary schools is that in the former there is a very close connection with the elementary school and consequently there is no class distinction entering into the question. In England it has been said that secondary education is received by children of middle-class parents who can afford to pay the fees, and by children of poorer parents who cannot afford to pay the fees and therefore enter by scholarship.

The American system of a stiff entrance examination puts the poor and rich student on an equal footing since the education is entirely free and the only requirement is brain power. Further, under the English system the hard-working "plodders" who would benefit by higher education and yet who are not clever enough to obtain the necessarily high marks for a competitive scholarship examination, are debarred from such higher education, although they could pass the lower standard of an entrance examination. One feels that the Americans are ahead in this respect, although in the working of the new English Education Act the above difficulty might be met by giving the head master of a school power to nominate students for scholarships to places of higher education without any examination, except the entrance test.

In studying the supply of public High Schools in different American cities one notes a great variation, as will be seen from the following table:—

Statistics of Public High Schools in Certain of the Larger American Cities.

City.	Population (1901).	Number of Public High Schools.	Number of Pupils.		
			Boys.	Girls.	Total.
New York	3,437,202	8[a]	7,034	9,514	16,548
Chicago	1,698,575	15[b]	4,380	8,259	12,639
Philadelphia	1,293,697	5[c]	2,349	2,876	5,226
Boston	560,892	11	2,756	3,286	6,042
Pittsburg	320,616	1	410	310	720
Minneapolis	202,718	4	1,223	1,875	3,098
Washington	278,718	5	1,255	2,096	3,351
Providence	175,591	4	781	1,023	1,804
San Francisco	342,782	4	637	1,061	1,698

(*a*) According to the syllabus for the year 1903–4 New York has now 17 high schools including the fine new Commercial High School.

(*b*) The South Side High School and the Manual Training High School have been amalgamated in one building which is called the University High School and which forms part of the Department of Education for Chicago University.

(*c*) This includes the Central High School which is usually considered to rank equal to a College.

The splendid system of public High Schools in Boston places that city first in the provision of Secondary Education. It will be noticed that the excess of girls over boys is more marked in the Western cities than in the cities of the North and South Atlantic States. The apparent deficiency of public schools in the case of Philadelphia is explained by the presence of the excellent private high schools in that city. The growth of American high schools is comparatively recent, since, in the year 1887 there were in Chicago only 2,000 scholars, of whom only 500 were boys; in Boston there were about 1,000.

The curricula in the different types of school vary according to the number of electives taken.

In *Washington* the course of study is as follows, for all except the Manual Training Schools: —

WASHINGTON HIGH SCHOOLS.

COURSE OF STUDY.

ACADEMIC.	SCIENTIFIC.	BUSINESS.*
English History Algebra Latin	English History Algebra German	English Business Arithmetic Book-keeping Penmanship Shorthand Geography *Typewriting or Commercial Drawing*
English English History *Greek* Geometry Latin Physics or Chemistry	English English History Geometry German Physics or Chemistry	English Applied Arithmetic Book-keeping Commercial Law Commercial Geography Shorthand Typewriting
English Latin *French* *German* *Greek* *Biology* or *Advanced Chemistry* or *Advanced Physics* *Political Economy* *Solid Geometry* *Trigonometry & Surveying* or *History*	English German or French *Biology* or *Advanced Chemistry* or *Advanced Physics* *French* *Political Economy* *Solid Geometry* *Trigonometry & Surveying* or *History*	Each year of this course is complete in itself. A special one year course is arranged for students of other high schools, who have done at least three years of successful work.
English Latin *Advanced Biology* or *Chemistry* or *Physics* *Greek* *History* or *Analytical Geometry & College Algebra* *French* *German* *Spanish*	English German or French *Advanced Biology or Chemistry* or *Physics* *History* or *Analytical Geometry & College Algebra* *French* *Spanish*	Students of the second year may substitute an equivalent amount of work in other subjects for Book-keeping or for Shorthand.

* This course does not prepare for the Normal School. Elective studies are italicised; all others are prescribed. Spelling is prescribed for all students. Drawing is prescribed for all pupils of the first and second years, also for Normal School candidates throughout the course.

Candidates for diplomas must pursue all the prescribed studies, and at least four studies in the third year. In the fourth year, pupils may take three major studies, with a total weekly programme of eighteen hours' work. Students who, from any cause, fail to meet these requirements, are enrolled as "unclassified," and cannot graduate until the prescribed work is satisfactorily made up.

Pupils who desire to prepare for college make special arrangement of their courses with the principal.

In the city of *Pittsburg* the high school comprises three departments—Academical, Normal and Commercial, the first and second having a four years' course, the third having only a two years' course. The program of study is as follows:—

First Year—D.

Academical Course.	Preparatory to Normal Dept.	Preparatory to Commercial Dept.
Drawing (2)	Drawing (2)	Penmanship (3)
Elocution (1)	Elocution (1)	Phonography (2)
English (3)	English (3)	English (3)
Algebra (4)	Algebra (4)	Algebra (3)
General History (3)	General History (3)	General History (2)
Botany (3)	Botany (3)	Physiology (1)
Latin (4) or	Latin (4)	Arithmetic (4)
Arithmetic (2) and		Commercial Geography (2)
Commercial Geography (2)		

Second Year—C.

Required Subjects.—Commercial Course.

Elocution (1)	Elocution (1)	Penmanship (3)
English (3)	English (3)	Phonography (4)
Geometry (4)	Latin (4)	Typewriting ($7\frac{1}{2}$)
History ($1\frac{1}{2}$)	Geometry (4)	Correspondence
Physiology ($1\frac{1}{2}$)	Chemistry (3)	Office Practice
Drawing (2)		

Elective Subjects,
(Choose 9 hours)

Latin (4)	Greek (4)	Physical Culture (1)
Latin Prose (1)	History ($1\frac{1}{2}$)	Book-keeping
German (4)	Physiology ($1\frac{1}{2}$)	Commercial Law (2)
Chemistry (3)	Music (1)	Commercial Arithmetic (4)
Drawing (2)		

The numerals in parentheses indicate the number of recitations per week. History ($1\frac{1}{2}$) means that this study is pursued three hours per week for one-half year. Recitation periods are 50 minutes long.

Courses of Study.

Third Year—Junior.

ACADEMICAL.	NORMAL.
Required Subjects.	
Elocution (1)	Drawing (2)
English (3)	Writing (1)
Physics (4)	Elocution (1)
	English (3)
	Physics (4½)
Elective Subjects.	Solid Geometry (1½)
(Choose 12 hours).	Advanced Algebra (1½)
Latin (4)	Zoology (2)
Greek (4)	History of Literature (1)
Greek Prose (1)	Education (½)
German (4)	Physical Culture (1)
Solid Geometry (1½)	Lectures on Geology and Astronomy (½)
Advanced Algebra (1½)	Music (½)
Zoology (1½)	Orthography (½)
History of Literature (1½)	
Drawing (1) (double period)	

Fourth Year—Senior.

Elocution (1)	Drawing (2)
English (3)	Writing (1)
Arithmetic (1½)	Elocution (1)
Geography (1½)	English (3)
U. S. History (1½)	English Grammar (2)
	History (2)
Electives.	Physical Geography (2)
(Choose 13 hours.)	Arithmetic (3)
Latin (4)	Book-keeping (1)
German (4)	Civics (1½)
Greek (4)	Education (2)
Mathematics (4)	Hygiene (2½)
Beginners German (5)	Music (½)
Civics (2)	Physical Culture and Orthography (1)
Geology (1½)	
Modern History (1½)	Science Review (½)
Drawing (2)	
English History (1)	

The numerals in parentheses indicate the number of recitations per week. U.S. History (1½) means that this study is pursued three hours per week for one-half year. Recitation periods are 50 minutes long.

The city of New York has now three kinds of schools, viz.: (1) Ordinary type, (2) Commercial, (3) Manual Training. Below is given the course of study for the first two types.

New York.

Course of Study.

(For all High Schools, except Manual Training and Commercial.)

Required. First Year.	Periods.
English	5
Latin, or German, or French	5
Algebra	5
Biology, including Physiology, Botany and Zoology, in different parts of the year	5
	20

Second Year.

Required.	Periods.
English	3
Latin, or German, or French	5
Plane Geometry	4
Greek and Roman History	3
	15

Electives.

Greek	5
German	5
French	5
Spanish	5
Chemistry	5

Third Year.

Required.	Periods.
English	3
Latin, or German, or French	5
English History	2
Physics*	5
Geometry and Algebra (second course)†	3
	18

Electives.

Greek	4
German	4
French	4
Spanish	4
Stenography and Typewriting	4
Book-keeping	3
Economics	3
Botany or Zoology	4

*A student preparing for college, who has already taken two foreign languages, may substitute a third foreign language for science specified. At least one period a week of Physics shall be devoted to unprepared work.

† Book-keeping may be substituted for Geometry and Algebra.

Fourth Year.

Required.	Periods.
English	3
A foreign language	4
Chemistry or Physiography or Biology*	4
English and American History and Civics	4
	15

Electives.

Physics, as in third year	5
Greek	4
Latin	4
German	4
French	4
Spanish	4
Mathematics	4
Stenography and Typewriting	3
Economics	3
Domestic Science (sewing, cooking, and household economy)	3
Commercial Law and Commercial Geography	3
Additional Latin or Greek or English	3
Mediaeval and Modern History	3

* A student preparing for college, who has already taken two foreign languages, may substitute a third foreign language for science specified.

General Provisions.

1. A period shall not exceed fifty minutes.

2. Drawing and art study shall be required two periods per week and vocal music one period per week throughout the first two years. Drawing and art study shall be optional one period a week throughout the third and fourth years. Those who intend to enter a traning school should take this course throughout the third and fourth years.

3. The equivalent of two periods per week shall be devoted to physical training throughout the course.

4. Drawing and art study, physical training and vocal music shall not be considered as subjects requiring preparation.

5. Of subjects requiring preparation, no student shall be required to take more than twenty-one periods per week.

6. No new class in an elective subject need be formed in the second year for less than 25 pupils; in the third year for less than 20 pupils; in the fourth year for less than 15 pupils.

7. Exercises in voice training and declamation shall be given at least once a week during the first year, and may be continued throughout the course.

8. In order to graduate from a high school a student must have studied at least one foreign language for at least three years, have accomplished satisfactorily all the other required work, and have taken a sufficient number of elective studies so that the total amount of required and elective studies shall equal 3,000 periods of work requiring preparation, and shall extend over not less than three and not more than six years. Due credit shall be given by the principal of a high school for work done by a pupil in other high schools.

9. A student's proficiency in each subject presented for graduation, shall be determined, in accordance with rules to be prescribed by the Board of Superintendents, by the examination conducted by the College Entrance Examination Board. A diploma of graduation shall be issued to each student who successfully passes this examination and who complies with the foregoing conditions. A certificate of having successfully completed the course of study for high schools shall be issued to each student who has complied with the foregoing conditions, but who does not take the above-mentioned examination.

The curriculum for the School of Commerce is entirely different from the foregoing, as may be seen below.

Course of Study.

New York High School of Commerce.

First Year.

Required.	Periods.
English	4
German, French or Spanish	4
Algebra	4
Biology (with especial reference to materials of commerce)	4
Greek and Roman History	2
†Business Writing	4
‡Stenography	2
‡Drawing	2
*Physical Training	2
Music	1
	25

Electives.	Periods.
Business Arithmetic	1
Commercial Geography	1

Second Year.

Required.	Periods.
English	3
German, French or Spanish	4
Plane Geometry	3
Chemistry (with especial reference to materials of commerce)	4
Mediæval and Modern History (with especial reference to economic history and geography)	3
Drawing	2
Stenography	2
Physical Training	2
	23

Electives.	Periods.
German, French or Spanish	4
Business Forms and Book-keeping	3
Business Arithmetic	1
Commercial Geography	1

* Including Physiology. † First half year. ‡ Second half year.

Third Year.

Required.	Periods.
English	3
German, French or Spanish	4
Algebra and Geometry	3
Physics	5
English History (with especial reference to economic history and geography)	3
Physical Training	2
	20

Electives.	Periods.
German, French or Spanish	4
Book-keeping and Commercial Arithmetic	4
Stenography and Typewriting	3
Drawing	2

Fourth Year.

Required.	Periods.
English	3
German, French or Spanish	4
Economics and Economic Geography	4
History of the United States (with especial reference to industrial and constitutional aspects)	4
Physical Training	2
	17

Electives.	Periods.
German, French or Spanish	4
A third language	4
Advanced Chemistry	4
Trigonometry and Solid Geometry	4
*Elementary Law and Commercial Law	4
Advanced Book-keeping, Business Correspondence and Office Practice	4
Stenography and Typewriting	4
Drawing	2

Fifth Year.

Required.	Periods.
English	3
Logic, Inductive and Deductive	3
Physical Training	2
	8

* Students who do not elect law in the fourth year may receive instruction in Commercial Law in connection with Advanced Book-keeping.

Electives.	Periods.
A foreign language	4
Advanced Mathematics	4
Advanced Physics	4
Industrial Chemistry	4
Economic Geography	4
(19th Century History, Europe and Orient; Diplomatic History, United States and Modern Europe)	4
Banking and Finance, Transportation and Communication	4
Administrative Law and International Law	4
Accounting and Auditing	4
Business Organization and Management	4
Drawing	4
Advanced Economics	3

General Provisions.

1. A period shall not exceed fifty minutes.

2. Drawing and art study, physical training and vocal music shall not be considered as subjects requiring preparation.

3. Of subjects requiring preparation, no student shall be required to take more than twenty-one periods per week.

4. No new class in an elective subject need be formed in the second year for less than 25 pupils; in the third year for less than 20 pupils; in the fourth year for less than 15 pupils.

5. Exercises in vocal training and declamation shall be given at least once a week during the first year, and they may be continued throughout the course.

6. In order to graduate from the High School of Commerce a student must have studied at least one foreign language for at least three years, have accomplished satisfactorily all the other required work, and have taken a sufficient number of elective studies so that the total amount of required and elective studies shall equal 3,000 periods of work requiring preparation, and shall extend over no less than three years and not more than six years. Due credit shall be given by the principal for work done by a pupil in other high schools.

7. A certificate of graduation shall be awarded at the close of the fourth year to each student who satisfactorily completes the work up to that point. The fifth year shall be regarded as supplementary to the regular course, and shall be open to all students who have graduated from a high school course of four years.

The Latin School of the New England cities are a distinct type of school giving facilities for students entering college.

The course of study in the *Boston* Latin Schools is as follows: —

BOSTON LATIN SCHOOLS.

COURSE OF STUDY.

Class VI. (lowest) Age 12–13.	Class V. Age 13–14.	Class IV. Age 14–15.	Class III. Age 15–16.	Class II. Age 16–17.	Class I. Age 17–18.
English & History - 6	English & History - 6	English & History - 5	English & History - 4	English & History - 4	English - - 2
Latin - - - 5	Latin - - 5	Latin - - 5	French or German - 2	French or German - 2	Physics - - $3\frac{1}{2}$
Geography - 2	Geography - $2\frac{1}{2}$	French or German - $3\frac{1}{2}$	Latin - - 4	Latin - - - 4	Latin - - - 4
Elementary Science - - $\frac{1}{2}$	Elementary Science - $\frac{1}{2}$	Elementary Science - $\frac{1}{2}$	Greek - - 5	Greek - - 5	Greek - - - $4\frac{1}{2}$
Arithmetic - 4	Arithmetic - $3\frac{1}{2}$	Algebra - - 4	Algebra - - 3	Algebra & Geometry - 3	Geometry - 4
Objective Geometry - $\frac{1}{2}$	Objective Geometry - $\frac{1}{2}$	Physical Training & Singing 2	Physical Training & Singing 2	Physical Training & Singing 2	Physical Training & Singing 2
Physical Training & Singing - 2	Physical Training & Singing 2				
Total hrs. - 20	Total hrs. - 20	Total hrs. - 20	Total hrs. - 20	Total hrs. - 20	Total hrs. - 20

The excellent progress made in America by the well-equipped Technical Institutes depends upon a good supply of adequately trained students from the secondary manual training schools, of which the following is a good specimen: —

Course of Study in the English High and Manual Training School—Chicago.

First Year.	Second Year.	Third Year.
Algebra - - - 4	Geometry - - 3	Chemistry - - 3
Biology (*a*) - - 4	Physics - - - 3	English or French - 3
English - - - 4	General History - 3	Solid Geometry (*b*) - 3
Freehand Drawing - 4	English or French - 3	Higher Algebra (*c*) - 3
Mechanical Drawing 4	Freehand Drawing - 1	Plane Trigomy. (*d*) - 3
Woodworking - - 10	Mechanical Drawing 4	Civil Government (*e*) - 3
	Foundry and Blacksmith's Work - 10	Political Econony (*f* 3
		Freehand Drawing - 1
		Mechanical Drawing - 1
		Machine Shop Work 10

a For 30 weeks or physiology for 10 weeks. *b* 12 weeks. *c* 12 weeks. *d* 16 weeks. *e* 16 weeks. *f* 24 weeks.

A few general impressions of the city high school curricula may be noted.

The boys' and girls' courses of study are very much alike, the numbers taking mathematics, chemistry or Latin, being about the same; some 55 per cent. of High School students take Latin in their course, Greek being studied by 7 per cent.; German comes next in popularity with 27 per cent. against 16·5 per cent. taking French; in the public schools of Cleveland and Milwaukee no French is taught, and in the latter city certain of the ordinary lessons are delivered in German.

About twice as many pupils take Physics as Chemistry, while the subject of Manual Training is taken by some 17 per cent. of the city high schools. The subjects of Physiology and Botany attract greater attention than in English schools, but on the other hand advanced mathematical work, receives somewhat poor treatment.

The general impression left on the visitor is that while the freedom from examination allows the American school to develop subjects without any reference to grant-earning

capacity, and makes them superior to the English Higher Grade School, nevertheless, the English city grammar school of a modern type has a greater depth of culture, and with increased support from public funds should prove no less efficient. The study of the American high school, however, is exceedingly fruitful in ideas for the organisation of the English municipal day secondary schools, *e.g.*, in the reduction of the number of scholars to each teacher; the provision of suitable gymnasia and out-door athletics; the formation of literary and scientific clubs among the pupils and the creation of an atmosphere of thoroughness and activity.

A few details of some of the high schools visited may be mentioned in passing.

The first school visited in New York was the fine new Wadleigh High School for Girls, which has no less than 2,800 scholars and 108 teachers (including seven men). Admittance for outsiders is by examinations held three times a year in January, June and September. There are about 1,520 pupils in the first year course alone, the numbers dropping off somewhat in the other years, although about 200 girls "graduate" each year. Considering the short time the school has been open the equipment is complete to the verge of luxury, a large sum of money having been spent on the decoration of the interior with works of art and the formation of a fine library. The school has no less than four Physics laboratories, Physics being a required study in all years; the Chemical department is smaller and hardly so well equipped, the balances being somewhat lacking in sensitiveness. All the laboratory notes are made up on the spot so as to avoid any over-pressure of home work. Members of the staff have at their disposal a well-equipped dark room for photographic work; a refectory, a cycle room and book room being also provided. The splendid cloak-rooms can be closed with shutters so as to turn on the heat and dry the clothing quickly.

The three gymnasia on different floors are fitted with every kind of appliance, including a running track, climbing poles, walking rings, horizontal boom, and "serpentine" framework. Step-practising and balancing are taught by walking along a

wooden rail 12ft. long by 10in. in height, with a flat top 3in. in width. Each piece of apparatus in the gymnasium is suspended by ball and socket joints from a slotted girder overhead, so that they may be pulled to one side after use.

No expense has been spared both in securing an able staff and a good equipment of apparatus and text books,—some of the classical texts being remarkable for their ornate illustrations.

The second school in New York which the writer saw was the De Witt Clinton High School for Boys, which at present occupies one main building and four annexes, although plans have been prepared to put up a fine building of $6\frac{1}{2}$ storeys high at a cost of £300,000. In this school there are some 2,300 pupils and 96 teachers, most of whom are specialists, a remarkable growth in numbers since Dr. Buchanan in 1897 came from the Kansas City High School to take charge of the "Clintonians," and started with 650 pupils and 21 teachers.

Of the science subjects, Physiology and Botany are taught to the majority of the pupils; the laboratory for chemistry is well fitted up but it is surprising to find the comparatively small number taking this subject. It is studied by fourth year students only, and Physics is taken by third year students, so that in both cases the work is scarcely of an advanced character. Science instruction is done by laboratory work, and "recitations" or "quizzes" on a portion of book work. The elaborately prepared lecture table is conspicuous by its absence, reference being made to the students' own laboratory work. The amount of book work to be learnt by rote seems to be due to a desire to acquire the facts quickly, since the subject is confined to a single year's course.

Some of the classical and mathematical work was of an extremely high order and the illustrated classical texts were again much in evidence. In teaching mathematics most American schools do not follow the sequence of Euclid so closely as in England before the reform of mathematical teaching, but the so-called "practical mathematics" syllabus is almost unknown to teachers in the States.

The writer had an opportunity of hearing an impromptu

school concert at the De Witt Clinton High School, and the proficiency of the pupils in singing was remarkable—the music including the Pilgrim's Chorus from "Tannhaüser"; a chorus from the "Messiah," interspersed with the school song, "Ye sturdy sons of Clinton," and the national song, "America." The pupils have four lessons a week in singing, and no less than three song books are used for the selections.

In athletics the pupils have teams for Baseball, Football, Hockey, Running and Swimming.

With regard to foreign languages the opinion of the teachers seemed to be divided, some disliking the oral method as used in grammar, although great stress was laid on speaking and answering in French or German. Essays and letters are written in the language as a means of acquiring literary style, and altogether the methods seem thorough.

Before leaving the school the principal explained the system of preparing during the last two weeks of the Spring term the time-table for the ensuing Session, so that everything was ready for the commencement of the Fall term.

Complicated and elaborate arrangements were rendered necessary owing to the wide system of electives, and the large number of pupils makes the task no easy one.

Many unique features were noticed in the visit to the Girls' Technical High School, New York, which is designed to give a special training in Commercial work and the Domestic Arts. The two years' curriculum includes typewriting, cookery, sewing, drawing, stenography, foreign languages, dressmaking, library work, type setting, and proof reading, &c.

Commercial methods are used throughout the School, *e.g.*, each morning four "news girls" write on the blackboard a summary of the newspaper reports divided into (1) foreign news; (2) general United States news; (3) local news; and (4) miscellaneous; the other girls criticising the points and asking for elucidation on points of geography or commerce arising out of the work.

The foreign languages are extremely well taught, pictures being used only as an aid to composition. The French reading books studied included Victor Hugo's "Vingt Treize" and

"Hernani" also Moliere's "Le Bourgeois Gentilhomme"; the German class were reading Goethe's "Hermann and Dorothea" and "Iphigenia," together with Schiller's "Wilhelm Tell." The Biological class were engaged in the study of a crayfish loaned from the Natural History Museum, the drawings being particularly good.

The New York High School of Commerce proved a most interesting visit, as the Principal had taken a prolonged tour through England and Germany before organising the curriculum. His opinion was that more ideas could be obtained from the German "Hohere Handelsschulen" and "Handels Hochschulen" (Business Schools and High Schools of Commerce), than from the work in English schools, although he expressed his admiration of the courses in the London School of Economics, and the commercial departments of Birmingham and Manchester Universities.

Although some of the fittings of the school were scarcely completed, the classes had been started with an entry of 1,000 students and a staff of 35 teachers. The elaborate nature of the architectural design of the building was shown by the system of elevators, the provision of an Assembly Hall to accommodate 1,300 persons, and the fine gymnasium fitted at a cost of £1,000. This gymnasium contains an anthropometric machine and is in charge of two qualified medical men; the swimming bath in the basement is fitted with nine dressing rooms and eight shower baths so that the physical needs of the pupils are well looked after. Arrangements are made for the provision of dinner to 400 boys at a cost of 5d. or 6d. per head.

The curriculum has already been given and a study of the same will indicate the liberal aims of the New York Board of Education with respect to commercial education.

The City of Philadelphia contains several high class public and private secondary schools, of which the writer had the pleasure of visiting the Roman Catholic High School and the Central High School. Dealing first with the Catholic High School, which was built some 12 years ago, with donations by Thos. Cahill, of the Knickerbocker Ice Company, the students

number 300 (all boys), mostly drawn from the 80 parochial schools in Philadelphia. The staff consists of a Rector and Pro-Rector—both clerics—assisted by 18 lay masters. The course of study lasts four years, with a post-graduate course of one year for pupils entering the Universities, the curriculum being arranged by the diocesan superintendent. Candidates for admission must bring certificates of recommendation and pass an entrance examination which is fairly difficult, since out of 240 candidates last year only 120 were admitted. Of the 500 pupils "graduated" since the opening of the school, many have taken up the study of dentistry, law and medicine; a few are drafted into the Seminary at Overbrook, and one or two have entered the U.S. Military Academy at West Point.

The course of study is a combination of Classical, Commercial and Manual Training, there being a common course for the first two years. In the third year Manual Training is replaced by Latin for the professional career, but no Greek is taught. The Manual Training consists of drawing, clay modelling, and wood carving, a special feature being that the pupils are taught to use both hands. Special rooms are provided for clay modelling, wood carving, architectural drawing and typewriting, the latter containing machines of various makes. A Chemical Laboratory holding 40 pupils and a Physics Room for 25 pupils are somewhat less elaborately fitted up.

Among the fine specimens of wood carving worked by the students were some types of Old English clock cases, an altar in the large Assembly Room, and vestment cases at the Churches of the Visitation and St. John the Evangelist.

This fine school, erected at a cost of £50,000, provides free tuition and books for all pupils from the Catholic Elementary Schools of Philadelphia, including the Catholic coloured schools.

Of the large Central High School in Philadelphia it may be stated that it supplies the place of a city college, as it offers a four-year course leading to the degrees of Bachelor of Arts or Bachelor of Science, with a post-graduate course of two years in the subject of Pædogogy.

The first school was erected in 1836 at a cost of £14,000 out

of funds distributed by Congress and arising out of surplus revenues. The new building was started in 1894, dedicated by President Roosevelt, and up to the present is valued at £300,000, the equipment costing a further sum of £25,000.

The annual appropriation out of the city rates for the year 1902 was £30,000, being at the rate of £18. 16s. 0d. per pupil. A brief description of the building will indicate its fine architecture. The main building is 170 feet by 222 feet, four storeys in height, with a basement and an interior courtyard 67 feet by 81 feet; the Annex is 110 feet by 180 feet and is also four storeys high. In the main building there are 10 laboratories, 73 rooms and a faculty and President's room. On the Broad Street front is a tower 32 feet by 28 feet, surmounted by the main astronomical dome, 28 feet in diameter, the top of the stone work of the tower being 137 feet above the street. There are two main stairways and two fire-escape stairways, also three elevators—two for passengers and one for freight.

The Philadelphia Astronomical Observatory occupies the space of the main tower and the main stairway above the fourth floor, and is 32 feet by 72 feet. It includes a large transit room and two equatorial domes, the western dome 17 feet in diameter, and the eastern dome 28 feet in diameter. Space has been assigned for a computation room, photographic room, library, clock room, concave grating room and astronomical class rooms.

On the first floor of the main building is a large lecture room seating 400 people, an alumni library and reading room and four general rooms; the second and third floors are taken up by the large assembly hall, with a total seating capacity of 1,750. The fourth storey is devoted to a gymnasium fitted with dressing rooms. Each floor of the main building is connected with the Annex by iron bridges 8 feet wide. The corridor floors are laid with mosaic and the rooms and corridors wainscotted with tiles. In the 64 years of the School's history nearly 19,000 students have passed through the school, and of these about 3,000 have graduated after the full four years' course of study; in 1903 there were 1,590 pupils and 58 teachers, the number of pupils graduating being 169, of which over 100 are studying at a Technical School or University.

There are five distinct courses in the curriculum, including:

(1) The Classical Course, comprising Latin, Greek, English, modern languages, mathematics, astronomy, physics, chemistry, drawing, biology, logic and ethics. During the Senior year students elect between French and German, while there are also optional courses in advanced Classics.

(2) The Latin-Scientific course, designed for those who wish to pursue both scientific and literary studies, and it differs from the classical course in omitting Greek. Extended instruction is given in two modern languages, mathematics, physics, and chemistry. In the Senior year elective courses offer advanced work in engineering, chemistry, physics and biology.

(3) The modern language course contains no Greek, and Latin is omitted after the Sophomore year. Fuller instruction is given in modern languages, physics, chemistry and mathematics. During the Senior year, elective courses offer more advanced work in engineering, chemistry and biology.

(4) The Course of Commerce instituted in September, 1898, includes English, modern languages, mathematics, history, natural and physical science, economics and political science, and business technique.

(5) The graduate course in Pædagogy is divided into a professional course as training in the science of education and the art of teaching, together with the scholastic course, which aims at perfecting the scholarship and skill of the student in the subjects taught in the elementary school. The practising school consists of two classes of the Grammar School grade.

No manual training is taught in this institute, such instruction being obtained in the three Boys' High Schools.

As regards entrance requirements, pupils from the elementary schools are admitted by an examination held in June each year; as a rule only residents in the city are entitled to admission, an exception being made in favour of sons of soldiers who served in the war of 1861—5.

All pupils must obtain a certain percentage of marks in class examinations before entering on the next year's work; in certain cases the pupil may take the class on "conditions" which must be removed within a certain limit of time.

It may at first sight appear a doubtful policy to grant degrees to mere youths of 18 or 19 years of age, the idea of so doing having been started by the State of Pennsylvania in 1849, but the influence of the alumni will prevent any change, except to extend the course to six years and thus make the degree more valuable. The Commercial Department of the High School seems to be growing rapidly, having in 1903 no less than 200 students (including 50 coloured pupils) and it should prove a good feeder for the Wharton School of Finance at the University of Pennsylvania.

Nothing is so striking as the fine facilities for reading given to the pupils, as the libraries include a Faculty Library of 1,800 volumes, the Students' Library, given by the Alumni Association and comprising 3,000 volumes; moreover, the Apprentices' Library of over 30,000 volumes is in the neighbourhood of the school and is much used.

The attention of the visitor to the school is drawn to the stained glass windows placed in the Assembly Room which is further adorned by Statues of "Minerva," "St. George," and the "Venus de Milo"—the latter presented by former students. The Physical Laboratory is well equipped, and the teacher has an ingenious arrangement of putting the experiments and papers of instructions in locked cupboards, the students receiving the key to the cupboard and verifying the state of the apparatus before proceeding with the experiments; in this way breakages are localised immediately. In Chemistry the pupils take the study of non-metals in the third year and metals in the fourth year; qualitative analysis is done in the fourth year, but no gravimetric or quantitative experiments are performed, and as a laboratory lesson in this subject is only of one hour's duration, the standard cannot be considered very high.

The Commercial Department possesses a number of stereoscopic views of countries for studying geography. A commercial testing laboratory has been instituted for the study of raw materials, and clays, sands, ores, colours, oils, fats, cotton, hemp and jute are examined by means of the blowpipe or microscope.

In the city of *Pittsburg* the High School system includes four courses, viz. :—

(1) Classical Course of 4 years.
(2) General Course of 4 years.
(3) Normal Course of 4 years.
(4) Commercial Course of 3 years.

Of the three public high schools the Central High School has the Classical Course, the General Course, the first two years of the Normal Course and the first year of the Commercial Course.

The Fifth Avenue School maintains the entire Normal and Commercial Course, while the South Side building has three years of the General Course, the first two years of the Classical and Normal Courses and the first year of the Commercial Course.

In the Session 1901–2 there were 1,888 pupils in the three schools; of this number 313 were in the Normal departments and 549 were taking Commercial courses.

The course of study in the different branches of instruction has already been indicated, but as the Commercial Department of the Fifth Avenue School has certain novel features it may be advisable to give a brief description of it. There are at present about 550 pupils and a staff of 16 teachers in the school, which is worked on similar lines to the Commercial Schools of Springfield (Mass.) and Boston (Mass.).* In the New York Commercial High School bookkeeping is elective, whereas in Pittsburg that subject is compulsory and is worked on actual business lines. Each pupil starts with a certain amount of paper money, say, $5,000 (£1,000), part of which is supposed to have been earned in the first year's course. The Commercial class room is fitted with several compartments, representing a bank, commission office, insurance office, real estate office, and various firms dealing

* Some of the private business schools are after the same style as the Pittsburg High School course, and the writer spent a pleasant day in studying the routine work of the Morse Business School at Hartford (Conn.). The success of such institutes may be due to the action of firms in refusing to employ clerks who are not fully qualified. The impatience and rush of modern commercial life in America is tending to shorten the probationary or apprenticeship period, and the youth is thus compelled to gain experience in schools of commerce and technology.

in produce. Four or five pupils work as partners in each office, and in the case of the business firms they follow out definite instructions given by the Superintendent of Practice. Business forms are used and tickets stamped with money values or amounts of goods represent concretely the means of trading. Prices are moved up and down every day according to a schedule, and the student is required to use the prices of the day. Selling takes place for cash, paper or consignment. If a pupil fails in business he must repeat his work and, moreover, is debited with his losses—in some cases he starts in a lower position as a Shipping Clerk or Insurance Clerk. The various sets of books are balanced from time to time, the Bank being obliged to strike a balance each day.

A few of the exercises taken at random from the book of instructions are given below:—

"Open an account at the bank, deposit your cash, and make the proper entries in your books."

"Address a letter to the Real Estate Agent proposing to rent a store, stating locality."

"Sell to James Wilson on his accepted draft at 30 days, 200 bush. Milwaukee Club Wheat."

"Write an advertisement to be inserted in the daily papers for a Shipping Clerk. State qualifications required and other conditions you may consider desirable."

†"Order on 30 days' time 700 brls. New Mess Pork; 900 bush. No. 1 Corn; 800 bush. Western Mixed Corn."

"Send to Commission House, to be sold on your account and risk, 1,000 lbs. Dairy Cheese."

"Your store is supposed to have caught fire at this juncture, and its contents damaged. Dispose of goods as directed in Instruction Book."

"Pay yourself one month's salary."

"Close your books preparatory to admitting a partner."

"Apply to the Insurance Office for Insurance on your store and contents."

† In carrying out this order one of the pupils was 50 bushels short at the end of the day and had to stand the loss.

"Apply to the Real Estate Agent for the purchase of a store, stating locality, &c. Write up a deed and have it signed, acknowledged and recorded."

It will be seen from the above quotation that the work is of a very practical and thorough character, and combined with the study of shorthand, typewriting, and foreign languages, the pupils receive a training which enables them to start at a fairly high salary with a business firm. Of course this method of learning book-keeping needs a good deal of attention on the part of the instructors in order to keep things straight. Sometimes the pupils get out of hand as witness the case of one girl who induced all the boys to sell her their real estate holdings, thus enabling her to create a "corner" and bring business and book-keeping to a standstill.

A unique feature in Pittsburg is that the Elementary and High Schools contain photographs of the exhibits in the Carnegie Institute, and the librarian, in conjunction with the Board of Education, sends out bulletins, giving references to books on the subject of drawing lessons. The Superintendent of Schools meets the school principals once a week to discuss educational topics.

In the city of *Chicago* the new University High School forms part of the Department of Education, and is an amalgamation of two private institutions, viz.:—The Chicago Manual Training School, and the South Side Academy, the latter being started by a number of professors partly as an experimental school and partly as a feeder to the Chicago University. The combined school now holds a position similar to that of the University Academy for boys at Morgan Park. Certain other High Schools come wholly or in part under the control of the University in educational matters, and are termed affiliated academies.

Graduates of such Secondary Schools are admitted to the University upon certificates in the various subjects required for admission to the University, each of these certificates to be signed by the principal and teacher who gave the instructions.

Entrance scholarships are awarded to graduates by the University, which also offers certain advantages in the purchase

or loan of books and apparatus. On the other hand, the affiliated school undertakes: (1) to consult with the University when appointments to the teaching force are to be made; (2) to conform its instruction as far as practicable to the standards required by the University. The writer was in Chicago during the Annual Conference of Affiliated Academies and High Schools in which the topic of discussion was the consideration of the following problems on high school work:—

(1) To connect the eighth grade of the elementary school with that of the secondary school.

(2) To extend the work of the Secondary School so as to include the first two years of college work.

(3) To reduce the work of the college work thus grouped together to six years, and in the case of good students to five years.

The general opinion appears to be in favour of shortening the time of study at college so as to enable the graduate to start his professional career earlier.

Of the other American cities amply provided with secondary instruction, Boston and Washington stand out pre-eminent, as the following figures will indicate:—

Boston—Population 560,892.

Public High Schools.

Name of School.	Number of Pupils. Boys.	Girls.	Total.
Brighton H.S.	90	175	265
Charlestown H.S.	104	263	367
Dorchester H.S.	195	365	560
East Boston H.S.	122	211	333
Girls' H.S.	0	1149	1149
English H.S.	902	0	902
Girls' Latin School	0	272	272
Mechanic Arts H.S.	508	0	508
Public Latin School	577	0	577
Roxbury H.S.	158	628	784
West Roxbury H.S.	100	225	325
Total (11)	2756	3286	6042

In addition to these public high schools Boston has 15 private schools containing 763 pupils receiving secondary instruction; the Boston College has 466 students; Boston University has 1,350 students; the Massachusetts Institute of Technology 1,277; and finally at Harvard University there are some 4,300 students; giving a grand total of 14,200 students in and around Boston, receiving instruction in secondary and higher education. Boston has therefore some reason for considering itself the intellectual centre of the Eastern States.

In Washington the five public high schools contain 3,351 pupils (including 740 in the Coloured High School), while the 22 private schools contain 885 secondary pupils among them.

This short account of American secondary education will indicate that, at any rate in the large cities the system of public education is most complete, and consequently all higher education can be built up on the solid foundation. The success of the universities, the schools of technology and the training colleges for teachers, depends upon the efficiency of the High Schools—a fact recognised, as we see, by the affiliation system of the University of Chicago. Until such a public system of education is put into operation in England the lack of adequate preparation will continue to compel the Universities to waste the first year of study on what is really secondary school work.

In view of the criticism passed on English Secondary Schools that their curriculum is drawn up mainly with the idea of preparation for college, it may be interesting to quote the report of the American Committee of Ten on secondary school studies.*

"The main function of the secondary schools of the United States is to prepare for the duties of life that small proportion of all the children in the country—a proportion small in number but very important to the welfare of the nation—who show

* This Committee, with President Elliot, of Harvard, as Chairman, organised a series of conferences on High School subjects, and the recommendations contained in their report (issued in 1903) have greatly benefited secondary education.

themselves able to profit by an education prolonged to the eighteenth year and whose parents are able to support them while they remain so long at school.

"The preparation of a few pupils for college or a scientific school should be the incidental and not the principal object. At the same time it is obviously desirable that the colleges and scientific schools should be accessible to all boys and girls who have completed creditably the secondary school course, no matter to what group of subjects they may have mainly devoted themselves."

Technical Education

TECHNICAL EDUCATION.

The first difficulty that the student of American technical education encounters is the diverse terminology and character of the institutions represented.

Without adopting any arbitrary classification it may be stated that various forms of industrial and technical education are given in:—

(1) Public and private Manual Training Schools.
(2) Schools of industrial drawing and design.
(3) Trade Schools.
(4) Technical and continuation schools.
(5) Institutes of Technology (including agricultural Colleges).
(6) Scientific schools of universities.

As in England, the idea of technical education has grown from the imparting of mere manual dexterity and elementary knowledge of machinery, to the training of the hand and eye combined with artistic skill and knowledge, and the study of methods of scientific investigation.

American educators have long ago perceived the influence of manual training in training the faculties necessary for the full development of the child, and one is therefore not surprised to find the subject taken in the elementary curriculum, starting as low as the commencement of the Grammar Grade (age 10). In the year 1901 manual training was taught in 169 school systems of cities of over 8,000 inhabitants; in the State of Massachusetts the subject has been made compulsory in both elementary and high school curricula in cities having more than 20,000 inhabitants.

In many places only simple exercises in drawing, woodwork and sewing are given. In other schools these subjects are compulsory, and, in the large cities, a special manual training high school has been formed where special courses in Carpentry and Metal work are taken alongside the literary

instruction. Among public schools of this class are the Mechanics' Arts High School, Boston; the Rindge Manual Training School, Cambridge, and the Philadelphia Manual Training School. The Chicago Manual Training School; the St. Louis Manual Training School, and the Hebrew Technical Institute, New York, were among the first private institutions to be established, the St. Louis school being in connection with Washington University. In these schools the curriculum includes freehand and mechanical drawing, carving, wood turning, pattern making, carpentry, moulding, forging, machine shop work, and practical work in physics and chemistry.

Under the heading of Trade Schools might be included the New York Trade School and the Williamson School of Mechanical Trades (Pennsylvania), both of which turn out students equipped for one particular branch of trade, the graduates being able to command full journeymen's wages after completing the course. The Waltham Horological Institute at Waltham (Mass) offers a one-year course of instruction in watch-making for workmen who wish to learn branches of trade other than the special work in which they are engaged, the fee for the twelve months being £40. Schools of Industrial Design were first established at Lowell (Mass.) and Philadelphia (Pa.) as an aid to students of the textile trades and from these institutes there arose the modern textile schools of which the institutions at Philadelphia, Lowell (Mass.), New Bedford (Mass.) and Raleigh (North Carolina) are examples.

Many of the so-called technical schools are polytechnics, in which instruction is given in Fine Arts, Domestic Arts, Science and Technology. As in English institutions of a similar type, both day and evening classes are held.* The Pratt Institute,

* With regard to evening instruction the better class schools of technology offer little or no encouragement in that direction, owing to the necessarily poor results obtainable. Many of the American teachers who have visited England expressed their astonishment at the large number of evening students and the small number of day students in our technical institutes. In Germany the technical high schools and, with few exceptions, the schools of engineering have day classes only, and it is considered absurd that mathematical and constructive work of a high standard should be performed by students whose minds and bodies are in need of a rest after the fatigue of a hard day's work.

Brooklyn; Drexel Institute, Philadelphia; and the Cooper Union of New York, are good instances of this class of work.

The older schools of technology were founded about the time of the Civil War, the Massachusetts Institute commencing in 1865, followed by the Worcester Polytechnic in 1868, and by the Stevens Institute, Hoboken, in 1871. Most of them are schools of science and engineering of collegiate grade, and their activity has been further promoted by the various Land Grant Acts, and by the beneficence of various wealthy citizens. Fuller mention of the "Scientific Schools" attached to colleges and universities will be made later.

Excluding for the present the institutes of technology and "Scientific Schools," and dealing only with the Institutes for manual and industrial training, we find that according to the statistics of the year 1900–01 there were in the whole of the United States 153 schools, with 1698 teachers and over 48,000 pupils. The total expenditure on teachers, materials, tools and repairs, etc., amounted to £164,600.

Statistics are given of some of the best known Institutions: —

Statistics of Institutes for Manual and Industrial Training, 1900—01.

Location.	Institution.	Grade of Literary Instruction.	Teachers.		Pupils.		Expenditure for 1900-01.
			Male.	Female.	Male.	Female.	
New Haven (Mass.)	Boardman Manual Training High School	Secondary	7	15	308	227	£6,160
Chicago (Ill.)	Manual Training High School	do.	13	0	279	0	£2,200
do.	Lewis Institute	Secondary & Collegiate	30	12	548	226	£2,700
Peoria (Ill.)	Bradley Polytechnic	do.	16	3	187	190	£1,360
Boston (Mass.)	Mechanic Arts High School	Secondary	15	2	508	0	£3,640
Cambridge (Mass.)	Rindge Manual Training School	do.	6	0	179	0	...
Lowell (Mass.)	Lowell Textile School	Secondary & Collegiate	15	1	375	24	...
St. Louis (Mo.)	Manual Training High School	Secondary	12	2	264	0	£1,200
Brooklyn (N. Y.)	Manual Training High School	do.	20	13	523	632	£1,790
do.	Pratt Institute	do.	3	3	99	154	...
New York (N. Y.)	Hebrew Technical Institute	do.	10	0	228	0	£5,000
do.	Trade School	do.	28	0	671	0	£7,600
Philadelphia (Pa.)	Central Manual Training School	do.	17	0	450	...	£2,400
do.	Drexel Institute	do.	55	30	1360	433	...
do.	Girard College	Elem. and Secondary	10	0	908	...	£3,360
do.	School of Industrial Art	Collegiate	28	7	704	297	£7,200
Providence (R. I.)	Manual Training High School	Secondary	15	7	238	93	£6,300

The character of the courses of study and the equipment of these Institutions may be gathered from the following detailed description: —

The St. Louis Manual Training School of the Washington University, St. Louis (Mo.), is one of the oldest in the States, having been started in 1872 as a secondary school preparing for the high grade engineering institutes. Its object is (1) to furnish a broader and more appropriate foundation for higher technical education, (2) to serve as a developing school for students of the practical arts, and (3) to furnish to those who are looking forward to industrial life the opportunity to become familiar with tools, materials, draughting, and the methods of machine construction.

The invested endowment is about £23,000, the income of which enables the school to offer annually between 50 and 60 free scholarships. The tuition fees for the three years are £15, £20 and £24 respectively, and the average age of admission is about 15 years. The curriculum in the *First Year* includes: mathematics, English, history, biology, botany, freehand and instrumental drawing, joinery, wood carving and wood turning; Latin, French and German are electives. In the *Second Year* chemistry is substituted for biology and botany—the manual training including pattern making, moulding and forging. Latin, French and German are again elective subjects. The *Third Year* course comprises mathematics, physics, civics and political economy, literature, drawing, metal work (original designs); with French and German as optional subjects. As regards the wood and metal work the school is equipped with every facility for teaching—no less than 51 speed lathes being used for wood work alone. The Forging Shop is 40 feet square and has a complete equipment of 25 forges, anvils and sets of tools; the blast for these forges is supplied by a power blower and a large exhaust fan secures good ventilation of the building. The machine shop, 40 feet by 50 feet, has an equipment of 16 engine screw-cutting lathes, 6 speed lathes, 2 planers, 2 drills, a 15-in. shaper, emery grinder and gas forge.

The proficiency of the pupils may be deduced from the fact

that three of the wood cutting lathes and two of the speed lathes were made on the premises. The members of a former class constructed a gas forge furnished with air from a chamber filled by an oscillating cylinder air pump. The director, Mr. C. M. Woodward, claims that the manual training has a remarkable effect on the development of the intellectual powers of the pupils and rouses the ambition of boys who are strong in executive ability. Further, the school life of the pupil is lengthened, since he is quite aware that proficiency in tool work is conducive to speedy advancement in engineering shops.

The Hebrew Technical Institute, New York, has for its object the technical education of Jewish youths, in such studies as will best fit them for success in mechanical trades. It was established in 1883, and is supported by voluntary contributions of members of the Hebrew Technical Institute Society, aided by an annual donation from the Hebrew Benevolent and Orphan Asylum Society.

The three-year course is offered to boys between 12½ and 16 years of age, and about one-third of the time is given to manual training, which includes woodwork, metal work, electrical work, and mechanical drawing.

An entrance examination in arithmetic, English, history, and geography is required of each pupil, and any pupil who does not show a sufficiently high standard of work at the end of the first year is summarily dismissed. Tuition books and tools are free and warm lunches are provided daily at a nominal charge of ½d. per head. The school possesses a reference library, chiefly of books on mechanical and scientific subjects, and there is a circulating library of general literature. The curriculum includes mathematics, English, physics, chemistry, freehand and mechanical drawing, woodwork, wood carving, metal work and electrical engineering. In the Session 1902–3 there were 101 first year pupils, 64 second year, and 46 in the third year, making a total of 211. Of this number 34 "graduated" at the end of the session. An evening course in tool-making has been started for young men in trade, and who wish to become foremen. When visiting the institute the writer was struck by the

home-made machines and apparatus in use, the electric switches and lantern slides for lectures having been made by the pupils, and a small alternating current transformer, a 4-in. induction coil, and a reflecting galvanometer were further evidences of their skill.

The third year pupils were engaged in making, for use on leaving the institute, a set of steel tools, including countersinker, callipers, centre-punch, surface gauge, adjustable square, and scratch gauge. In the special drawing class the boys were preparing to leave and were doing a set of drawings to show employers. The principal of the Hebrew Technical Institute has made enquiries into the positions of the old pupils, and finds that the material benefits resulting from the education are evidenced by the increased earning capacity. Specimens of metal work on which the pupils were engaged were of a fairly advanced character, including a radial mill nut and bolt shaped on the milling machine; the nose of a lathe; a twist drill cutter; spiral mill tap and surface plate; a crank shaft and bearings; and a shaft coupling polished by tool without using emery cloth. In the woodwork department the students had designed and built a cottage, one-quarter size. The standard of work is stringently maintained, and 10 out of 57 students were withdrawn at the end of the first year and 6 out of 71 at the end of the second year course.

The New York Trade School, New York, is an incorporated institution managed by a board of trustees, and under the supervision of various trade associations, including the Plumbers, Painters and Decorators, Steam Fitters, Pattern Makers, and the General Society of Mechanics and Tradesmen of New York. Instruction is open to young men between the ages of 17 and 24, and comprises house painting, fresco painting, sign painting, blacksmith's work, steam and hot water fitting, bricklaying, plastering, sheet metal work, carpentry, pattern making, printing, plumbing and electrical work. The duration of its course is six months, viz.: from the middle of October to the first week in April; for each subject a fee varying from £5 to £7 is charged for the

complete course of three evening sessions. For the day session of four months duration the fee for each subject is £8.

Founded in 1881 by the late Colonel R. T. Auchmuty as a means of supplying knowledge of trades to apprentices, the school has achieved remarkable success, having educated no less than 10,000 young men since its foundation, and with a total enrolment for the Session 1901–2 of 229 day students and 457 evening students. Further, the courses of lectures for journeymen electrical workers and steam engineers were attended by 87 and 69 students respectively. The lecturer for the above subjects, who is a consulting engineer in New York, has just been appointed Director of the proposed Pittsburg Technical Institute, which is to be endowed by Mr. Andrew Carnegie with a sum of £4,000,000. A visit to the New York Trade School gives one the impression that building operations are going on. Starting in the basement, the visitor sees the bricklaying class, comprising some 40 students, each building an 8 in. or 12 in. straight wall, advanced students being engaged on the erection of piers, arches, flues and fireplaces. The brickwork is carried up to a convenient height and then, after inspection, is torn down by day labourers and the bricks cleaned for the next exercise. The next course is the Fresco Painting class of 22 youths engaged in a preliminary course of wall-work, painting and freehand drawing. The walls are arranged in alcoves, each 6 feet by 9 feet, and are covered with original designs in relief work, appliqué or squirt work, and frieze work in oil. It is interesting to note that many of the students in this class have formerly been clerks. Another class is engaged in general painting including graining, marbling, staining, and hard wood finishing (an imitation of inlaid wood work). The smithy shop seems rather small compared with the other departments; it is equipped with 12 forges fitted with an exhaust system and patent blast, the work comprising general smithy work, tool making, railing and ornamental work.

The plumbing shop, 37 feet by 112 feet in size, is fitted with the ordinary benches and capable of holding erection work such as basins, boilers, sinks, wash trays, &c. The first and second year classes have each 100 students, for whom 5

instructors are required. The fee for the day class is £8 for a course of four months, with £1 extra for the special class in lead "burning." The instructor in the last-named subject has just patented a new blow-pipe for lead "burning," requiring ordinary gas, gasoline or acetylene. Instead of "wiping" a joint a seam can be burnt flat, hence the process is cheaper. Its use might be extended to the acid tanks used for digesting wood pulp.

In the Carpentry shop a class of 19 were engaged on house carpentry and framing. Owing to the predominance of wooden houses in country districts special attention is paid to their construction, and the writer was shown a beautiful frame house, small sized, built by last year's class. The printing department is fitted with hand and rotary machines, and contains 200 cases of "job" type. The instructor explained the absence of a linotype machine as being unsuitable except for book work and newspaper work, but the course is certainly incomplete without it. In the electrical fitting class some 30 students were ranged on scaffolding and ladders in a large room measuring 112 feet by 65 feet. The work comprised bell and telephone circuits, burglar alarm systems, and other conduit work. The intense keenness of the students and the rapidity of working was most noticeable—they could not have done more if they had been on "piece" work.

Certain exhibition work in cornice work and sign painting was most ornate, and one was not surprised to find that employers compete for the services of the pupils who have been through the course. When it is considered that some of the pupils are paying fees amounting to £8 for 4 months' tuition, together with £4 a month for board and apartments, and are foregoing wages, the determination and grit of these workmen is conspicuously illustrated.

The Cooper Union, New York, has certain resemblances to an English technical school in a large city, in so far as it has a good day art school and a strong evening science school, the day science school being poorly attended. It is unique in one respect, viz., all the classes, whether day or evening, are free,

in accordance with the terms of the founder's wishes. The provisions in Mr. Cooper's trust deed specify (1) the provision of free evening instruction in all subjects tending to improve and elevate the working classes; (2) the provision of free reading-rooms, galleries of art and scientific collections; (3) the provision and maintenance of a school of design for women; (4) the provision and maintenance of a polytechnic day school. The institute started with a generous donation from the founder and his partner in the firm of Cooper and Hewitt.*

The lofty aim of the founder has been assisted by the beneficence of leading citizens of New York, and the Institute has now, in addition to the original endowment of £220,000, a general endowment amounting to £430,000. Tuition is free to all classes and even residence in New York is not a necessary condition; the only requirement is a letter of recommendation from an employer and a guarantee that the applicant is not able to pay for instruction. The day school is used mainly by the women's art department, although a day science department has recently been started and is gradually increasing in numbers. The evening classes are exclusively reserved for men except the elementary classes in perspective and architectural drawing, to which women are admitted. A special science course of five sessions duration leads to the degree of Bachelor of Science; evening courses are also offered in chemical analysis, naval architecture, art, and electricity.

The Bachelor of Science † course is as follows:—

First Year. Algebra, Geometry, Chemistry, Civics.

Second Year. Algebra, Geometry, Chemistry, Physics, Civics.

Third Year. Descriptive Geometry, Analytical Geometry, Physics, Theory of Electrical Measurements, Civics.

* By the recent death of Abram Hewitt in January, 1903, the Institute has suffered an irreparable loss, as in addition to giving a donation of over £50,000 he has acted as trustee and secretary of the Board for over 40 years, and on him has devolved the carrying out of the original plans.

† In 1902 46 students received this degree and 27 students graduated in the special Chemical Analysis course

Fourth Year. Analytical Geometry, Differential and Integral Calculus, Mechanical Draughting, Civics.

Fifth Year. Applied Mechanics, Higher Physics, Physical Laboratory, Chemical Laboratory, Machine Design, Civics.

The degree of Civil Engineer, Mechanical Engineer, or Electrical Engineer, is conferred upon graduates of the Institute after a suitable period of engineering practice.

In connection with the newly constituted day science school, it is proposed to establish 100 free scholarships, for the maintenance of pupils whilst studying—these scholarships to be awarded mainly to deserving youths nominated by the trades' unions of New York and elsewhere.

The evening instructors number 53; the day instructors 25; and there are 6 librarians and 1 custodian of the industrial museum. For the Session 1901-2 the number of students were :—

School of Science (Evening)	1130
„ „ (Day)	83
Naval Architecture Class	140
Women's Art School (Day)	250
Evening Art Department	1480
Stenography and Typewriting Class (Day) ...	45
Telegraphy Class (Day)	23
Elocution Class	128
Debate and Oratory Class	127
Total	3406

The equipment of the Institute itself has been performed on a lavish scale. The Art School alone occupies 22 rooms, with an aggregate floor space of 30,000 square feet, and is maintained at a cost of £5,000 per annum. A fine industrial Museum, organised by the granddaughters of Mr. Cooper, contains a set of tapestries presented by Mr. J. Pierpont Morgan. The Institute has a good Reference Library presented by the alumni. The Chemistry Department possess a qualitative laboratory for 96 students and a quantitative laboratory holding 44 students. The large Physics Lecture Room, fitted with projection lantern

and screen, has a seating capacity for 365 students. The physics and electrical laboratories were, in the writer's opinion, superior to many of the laboratories in the best American colleges, the fittings showing great originality. Amongst the apparatus may be mentioned a special form of Regnault's apparatus for the expansion of mercury; a new Boyle's Law apparatus; a thermostat for the comparison of thermometers; an electric clock connected to "tappers" in various parts of the laboratories for time experiments, and a telephone switchboard used for distributing the current from the storage cells. Galvometers were mostly of Rowland's pattern fitted with a reading telescope and the scale hinged so as to tilt up above the instrument when not in use.

In the electrical engineering laboratory a comprehensive set of machines were used for testing purposes. The storage batteries included 24, 5-ampere cells; 4, 50-ampere cells used for testing ammeters; and 12, $2\frac{1}{2}$-ampere cells for the circuits in the laboratory. The dynamos and motors included: —

1 G.E.C. compound D.C. 245 volts.
1 Westinghouse 10 H.P. two-phase rotary convertor.
1 Westinghouse 1 H.P. 50 volt alternator.
1 G.E.C. $2\frac{1}{2}$ H.P. 230 volt machine.
1 Crocker-Wheeler 4 pole — $5\frac{3}{4}$ K.W. 250 volt (compound machine).
1 G.E.C. 10 H.P. 230 volt (shunt machine).
1 G.E.C. 5 H.P. 230 volt (compound machine) with 2 commutators connected at right angles.
1 Sprague motor-generator 240 volts 50 amperes.
2 Rotary convertors $2\frac{1}{2}$ H.P.
1 Stanley two-phase induction motor—1 H.P. 120 volts.
1 G.E.C. 10 H.P. motor, with speed varying from 300 to 1200 revolutions per minute for use in the bracket cradle method for efficiency test.

The other scientific laboratories were fitted with an equally splendid equipment, and the visitor could only wish that the newly instituted day courses might attract students properly qualified to take advantage of the tuition.

Let us next turn to the Pratt Institute of Brooklyn (N.Y.) which approximates to a London Polytechnic as regards the character of the work. This private institution which was founded in 1887 after several years' investigation of similar European institutions, has seven departments devoted respectively to: (1) High School work; (2) Fine Arts; (3) Domestic Art; (4) Domestic Science; (5) Science and Technology; (6) Kindergarten work; (7) Library work.

The Institute, which has an endowment of £500,000, and a total income, including fees, of £50,000, occupies six buildings, the main building being 100 feet by 86 feet, and six storeys high. The trade school building is 32 feet by 110 feet, and four storeys high, and contains large steam and electrical laboratories, as well as workrooms for trade classes. The library of 200,000 volumes is fitted with a general reading room, a children's reading room, a reference room, and a special photographic room, the latter containing 16,000 mounted photographs illustrating architecture, sculpture, painting and ornament.

The curriculum of the Pratt Institute High School is noteworthy for the fact that no less than two-fifths of the entire time during the course is devoted to manual training, and consequently the school serves as an excellent feeder for the department of Science and Technology.

The art school offers a four-years day course; a two-years day course in modelling, designing, architectural drawing, art metal work and wood carving, evening classes being held in cast drawing, design, clay and wax modelling, etc.

The department of domestic science includes (1) a normal course for teachers, comprising hygiene, cookery and laundry work; (2) an evening course in cookery. In the department of domestic art there are courses in Sewing, Dressmaking, Millinery, Art Needlework and Basketry, and there is a two-year course in the school of library training. A full-day course in art, science and technology costs £3 per term; evening classes in art cost £1 per Session of six months; in science £3; in millinery £5. The department of science and technology offers: (1) a 2-year day course in applied electricity and in steam and

machine design; (2) evening technical courses in physics, chemistry, mechanical drawing, steam, and strength of materials; (3) evening trade classes in carpentry, machine work, plumbing and sign painting. For the school year 1901-2 there were in the Science department 191 day students, 251 evening technical students and 169 trade students, making a total of 463 for the preceding year.

Excluding the High School, which has about 300 pupils, there were 864 students in day classes and 638 in evening classes, the large number of day students differentiating the Institute from some of our English polytechnics.

In the day classes for science and technology the writer noticed a number of students who had already been in engineering works and were fitting themselves for higher posts in machine shops and tool works. For the two years' course the expense of fees, books, instruments, would cost these pupils £25, and in addition they would have to pay 20s. to 24s. per week for board and lodgings. The sacrifice and determination thus shown would undoubtedly be a strong factor in the successful attainment of their aim.

With regard to the curriculum in this department the following is the course of study for:—

A. The two year course in steam and machine design, and

B. The two year course in applied electricity.

COURSE OF STUDY, "A."

PRATT INSTITUTE, BROOKLYN.

STEAM AND MACHINE DESIGN.

The figure after each study represents the number of periods a week.

FIRST YEAR.

Fall Term.		*Winter Term.*		*Spring Term.*	
Mathematics (Algebra)	5	Mathematics (Plane Geometry)	5	Mathematics (Plane Trigonometry)	5
Physics (Mechanics)	5	Physics (Heat and Light)	5	Physics (Electricity)	5
Physical Laboratory	6	Physical Laboratory	6	Physical Laboratory	6
Mechanical Drawing (Projections)	8	Mechanical Drawing (Shop Drawing)	8	Mechanical Drawing (Engine Details)	8
Machine Sketching	1	Machine Sketching	1	Machine Sketching	1
Shopwork (Carpentry and Pattern making)	10	Shopwork (Pattern making and Foundry)	10	Shopwork (Forging)	10

SECOND YEAR.

Mathematics (Advanced Algebra) 5	Mathematics (Solid Geometry) 5	Mathematics (Analytical Geometry) 5
Mechanism and Mechanics 5	Strength of Materials and Steam 5	Steam Engine and Transmission of Power 5
Machine Design 10	Machine Design 10	Machine Design 10
Strength of Materials Lab. 8	Steam Laboratory 8	Steam Laboratory 8
Shopwork (Machine Work) 10	Shopwork (Machine Construction) 10	Shopwork (Tool-making) 10

COURSE OF STUDY, "B."

APPLIED ELECTRICITY.

The figure after each study represents the number of periods a week.

FIRST YEAR.

Fall Term.	*Winter Term.*	*Spring Term.*
Mathematics (Algebra) 5	Mathematics (Plane Geometry) 5	Mathematics (Plane Trigonometry) 5
Physics (Mechanics) 5	Physics (Heat and Light) 5	Physics (Electricity) 5
Physical Laboratory 6	Physical Laboratory 6	Physical Laboratory 6
Chemistry (Non-metals) 2	Chemistry (Metals) 2	Chemistry (Qualitative Analysis) 2
Chemical Laboratory 5	Chemical Laboratory 5	Chemical Laboratory 5
Mechanical Drawing (Projections) 6	Mechanical Drawing (Shop Drawing) 6	Mechanical Drawing 6
Shopwork (Carpentry and Pattern-making) 6	Shopwork Pattern-making and Foundry) 6	Shopwork (Forging) 6

SECOND YEAR.

Mathematics (Advanced Algebra) 5	Mathematics (Solid Geometry) 5	Mathematics (Analytical Geometry)
Mechanism & Strength of materials 3	Steam and the Steam-engine 3	Steam-engines and steam-boilers 3
Applied Electricity (Generation) 4	Applied Electricity (Transmission) 4	Applied Electricity (Motors & Lighting) 4
Applied Electricity (Laboratory) 8	Applied Electricity (Laboratory) 8	Applied Electricity (Laboratory) 8
Mechanical Drawing (Dynamo Details) 8	Mechanical Drawing (Wiring Plans) 8	Mechanical Drawing (Power Plants) 8
Shopwork (Vise-work) 6	Shopwork (Machine-work) 6	Shopwork (Dynamo Construction) 6

When the writer visited the school some of the students were engaged on work for the St. Louis Exhibition, and in process of construction were a milling machine, a triple geared shaper with 20in. stroke, a six-tool turret lathe, a twist drill grinder, and a spiral milling cutter. Shop methods are introduced throughout the classes, *e.g.*, in the elementary work the pupils entering the engineering workshop go to a board on which are placed two brass checks opposite the student's number; one of these checks signifies the set of tools to be used, the other the number of the exercise. The students assemble and erect a machine and at the same time gain experience in making the milling cutters, taps and other special tools necessary for its construction. The tool shop equipment includes 23 lathes (16 with 6ft. bed and 14in. swing; 4 with swings varying from 17in. to 24in. and 3 new ones with 8ft. bed and 14in. throw); 4 drill presses; 5 grinders, and a magnetic pull 6in. by $\frac{1}{2}$in. which with $3\frac{1}{2}$ amperes of current requires 480lbs. to pull off vertically and 167lbs. tangentially.

The steam laboratory is fitted with plain slide-valve, automatic cut-off, and Corliss engines, as well as a 14-h.p. Climax gas engine, simple and compound steam pumps, air pumps, etc. The Strength of Materials Laboratory is equipped with the Olsen 100,000lbs. testing machine for tension and compression tests and also a 1,000lbs. hand-power machine. In the Physics Department there are four laboratories, two lecture rooms, a weighing room, and a special photometer room, the apparatus being mostly designed on the premises. A large number of the experiments deal with the effect of forces acting on beams, girders and cranes. The pattern shop is fitted with twenty-five 14in. lathes besides two circular saws, two planers, band saws, etc. In the Foundry is a cupola of one ton melting capacity for iron castings, two brass furnaces, a core oven, 24 moulding benches and sets of tools with a travelling crane for hauling a large weight of metal. In the forge shop are 25 forges furnished with air blast driven by a separate motor. The demand for admission to the machinists' evening class always exceeds the accommodation and the reputation of the practical benefit to be derived from the course is so great that names are

booked on the waiting list a year ahead. The chemical department contains laboratories for general, qualitative, and quantitative work respectively. The benches are made of soapstone, a material which marks easily but which is unaffected by acids and which can readily be cleaned with kerosine or linseed oil; a wooden slab for writing notes pulls out of the bench which is arranged so that when the cupboard closes all the drawers are locked automatically. The quantitative laboratory is fitted with white tiles on the top of the benches; as an aid to memorizing chemical symbols the reagent bottles have raised letters and only indicate the formula and not the name of the material.

Chemistry is taken by first year electrical day students—lectures for two hours per week and laboratory for five hours per week, the latter comprising general and qualitative work, but no organic work is done in either day or evening classes. An interesting feature of the science and technology department is the annual publication of the experimental work presented by the students as qualifying for the diploma. The reports for 1900—01 include such themes as "Determination of the relative accuracy of different methods for the quantitative analysis of coffee." "Comparative tests of gas burners with a Lummer-Brodhun photometer," "Tests of water rheostats," "Design of a 4-kilowatt rotary convertor," "Design of a combined pump and air compressor for steam vehicles." Among the students' reports for 1901–2 are "The construction of an armature winding for a five horse-power motor," "Quantitative analysis of arsenic," and "A cord-coupling device for engine indicators." The originality of some of these reports is rather apparent than real, nevertheless the student receives practice in applying scientific methods to the solution of commercial problems. In the opinion of the principal of the Pratt Institute, secondary technical training of this type might be further extended, since a great number of the students wish to have a short period of training on top of the first two years of the high school course. Taking the pupils from the age of 16 to 18 with a good two-years' course in practical mathematics, physics, shopwork, and mechanical drawing, a more scientific and technical course might be given than exists at present in the manual training school.

The Drexel Institute, in Philadelphia, belongs to the third largest city of the United States with a population of 1,300,000, and which, above all other American cities, has always been noted for its manual training institutions and engineering industries. Counting the two manual training schools, there are eight institutions which offer courses in design, drawing, or shop work. The Girard College has an excellent course in wood and metal work, electricity and plumbing, and the Pennsylvania School of Industrial Art is noted for its textile classes. As showing the unique opportunities offered to female workers the Spring Garden Institute has large classes in drawing open to women, one-third of the staff in the Drexel Institute are women, and rather more than one-half of the students are of the same sex. Founded in 1891 by Mr. Anthony J. Drexel, a wealthy banker in Philadelphia, for the promotion of education in art science and industry, the institute has now some 3,400 students, of which 1,200 are day students. The cost of erection was £200,000 and a further endowment of £400,000 given for maintenance. The institute is organised with 14 departments, including Fine and Applied Art, Science and Technology, Commerce and Domestic Science and Arts, Library School, etc. Free Evening Classes in choral music are also held. The efficiency of the Institute is increased by the provision of a library which contains 30,000 volumes, a museum containing important collections of textiles, wood carving, metal work, ceramics, tapestries, and the fine collection of paintings in the Lankenau Picture Gallery which is open free to the public. Two-year day courses are offered in architecture, design, electrical engineering, mechanical drawing, machine construction, dress-making, millinery, cookery, etc., the fees ranging from £2 to £7 per term for each subject in the day and from 10s. to £1 for evening classes. The income from fees and the interest on the endowment amount to £30,000, which is approximately the expenditure each year.

The building itself is a fine specimen of architecture of the classic renaissance style, and is unlike many of the American technical institutes which, although lavishly equipped inside have anything but a pleasing exterior. The arch of the portal

is ornamented by a series of high relief medallion portraits: Bach representing music; Raphael, printing; Goethe, poetry; Columbus, navigation; Newton, mathematics; Jefferson government; Faraday, physics; Shakespeare, drama; and Michael Angelo, sculpture. Inside the main building the most prominent feature is the great court, sixty-five feet square, extending up the entire height of the building, and covered with a decorated ceiling, the centre of which is filled with stained glass. A double marble stairway ascends to the upper storeys and arcades support and enclose the broad galleries which run round the court on the second and third floors. The entrance hall and central court are wainscotted in marble and the woodwork throughout the building is polished oak. The fine auditorium, which has a seating capacity for 1,500 persons, is arranged without gallery, but has a slightly sloping floor.

A gymnasium on the fourth floor is fitted with every appliance, and contains dressing rooms, bath rooms, lockers, etc. The museum, commenced by the present Principal—Dr. MacAlister—in 1891, with the co-operation of the late Sir Philip Owen, Director of the South Kensington Museum, has been gradually augmented by generous gifts, until it has now probably the finest collection of ceramics, wood carving and oriental metal-work of any institution in the United States; the Museum and Picture Gallery form a splendid adjunct to the work of the Department of Fine Arts and Designs.

Among the interesting items of the courses are:—

(1) The library course of one year, which is limited to 20 students and for which an entrance examination is held; the subjects of study include cataloguing, library economy, the study of books, and printing, together with practical work in the institute library.

(2) Junior and Senior Courses in Domestic Science and Arts; the curriculum for the two year Junior course in this subject includes, English language and literature, general history, mathematics, cookery, sewing, millinery, business accounts, drawing, civics and physical training. Having graduated in the junior course the student takes up advanced work in physiology, hygiene, cookery, millinery or dressmaking,

with a view to following it up as a profession. The cookery department is fitted with gas stoves and a separate outfit to each bench, similar to the arrangement of a chemical laboratory. A Pasteur filter is used to ensure a pure water supply. In the laboratory there is a fine group of samples of chemicals contained in food-stuffs, organic chemistry being prescribed as a study in the advanced course of domestic science. A dining room is fitted with special furniture so that the arrangement for a complete table d'hote dinner may be fully illustrated.

(3) The mechanical course which, like the Pratt Institute course, is worked entirely on trade principles, *e.g.*, each student has 10 checks by means of which he is enabled to borrow different tools, to be returned at the end of the lesson. The third year students were engaged on a six-inch lathe and two 10-inch shapers; other completed work included three direct current 1-h.p. motors, a 12-h.p. marine engine, a 16-inch lathe, and a horizontal engine. Many of the pupils enter the Baldwin Locomotive Works, or Messrs. Cramp's Shipbuilding Yards. A foundry, equipped with 17 down-draught forges made by the Buffalo Forge Co., gives a comprehensive training, as shown by the beautiful wrought-iron gateway in the Institute. The two-year graduate course in architecture offers a general course in drawing, design, decoration and building construction, to enable a student to take a good position as an architectural draughtsman. In the Art Department great attention is paid to the study of design—a three years' course in that subject being offered.

The Physics and electrical laboratories comprised a number of small detached rooms assigned to special purposes, *e.g.*, high voltage testing, resistance measurements, etc.

The Strength of Materials Laboratory has only been recently inaugurated and was not in good working order when the writer visited the Institute.

The chief feature of the courses in the Drexel Institute is the breadth of general culture acquired in addition to the technical training, a point which is often lost sight of in technological schools.

Textile Schools.

These schools received their first impetus from the formation, in the year 1884, of a Textile Department in the Pennsylvania Museum and School of Industrial Art at Philadelphia, which now receives annual grants from the State (£3,500) and from the City (£2,000) to carry on its work.

In 1895 the State of Massachusetts passed a Bill authorising the establishment of textile schools in cities with 450,000 spindles and over, and granted State aid to the amount of £5,000, provided the city appropriated an equal amount for the purpose of technical instruction.

The first school started under this Act was the Lowell Textile School, organised in 1897, followed by the New Bedford School in 1899, and the new school at Fall River in 1900. One of the conditions laid down in these schools was that non-resident students should pay a fee of not less than £30 per annum.

The cities in the southern cotton growing States have introduced textile courses into their technological institutes, notably at Cremona College, South Carolina; the College of Agriculture and Mechanic Arts, Raleigh, South Carolina; the School of Technology, Atlanta, Georgia; and the Mississippi Agricultural College, Stockville, Mississippi.

Dealing first with the Philadelphia Textile School and School of Applied Art, it may be desirable to mention that the large day attendance (490) is kept up by a series of scholarships, each county in the State being entitled to at least one free scholarship in any department for the full course of three years. These appointments are made by the Governor of the State on the recommendation of members of the State legislature. There are also 17 free scholarships offered to pupils in the public schools of Philadelphia.

The fees are £30 per session for the day course, except in

the class for ingrain carpet work, which costs £15. The evening fees vary from £3 to £5 per session.

The course in applied art includes industrial drawing, applied design, decorative sculpture, water-colour painting, illustration, interior decoration, whilst special classes are held for woodwork, metal work and basketry. The designing faculty is exercised from the beginning—the student thinks in terms of wood, iron, clay or other material; and, by means of stencil work the pupil seeks not to make an exact picture but to evolve his ideas after the Japanese style. In the advanced design class the students are given an outline copy of an interior, *e.g.*, a Greek or Roman building, and they are required to work out the colour scheme with given materials. In the textile course there are about 100 day pupils and 200 evening students, with a staff of 20 teachers. The courses include the regular course of three years' duration, a two years' cotton course, a two years' wool and worsted course, a two years' silk course, a two year chemistry and dyeing course, and a one year ingrain-carpet course.

The curriculum of the regular course is as follows:—

First Year. Weave formation: analysis and structure of fabrics; colour harmony; principles of design; mechanical drawing; Jacquard design; warp preparation and weaving; chemistry; carding and spinning.

Second Year. Weave formation; fabric analysis; Jacquard sketching, design and colouring; wool and worsted spinning; machine drawing; warp preparation and weaving; chemistry; dyeing; wool and worsted cloth finishing.

Third Year. Advanced work in the subjects of the second year.

The Institute is fitted up with rooms devoted to: (1) Wool preparation, carding and spinning; (2) worsted drawing and spinning; (3) cotton carding and spinning; (4) winding, spooling and twisting; (5) silk reeling, winding and warping; (6) hand-loom weaving; (7) power-loom weaving; (8) chemistry and dyeing; (9) card cutting.

The hand-weaving laboratory contains 18 looms for cottons and unions; 24 looms for worsted and woollens; 7 Jacquard looms, and 8 looms for silk and special work.

The power looms include 13 for cottons, nine for woollens and worsteds, three for carpets, and eight for silk and special fabrics. The dyeing and finishing laboratories are not so well equipped as other departments in the Institute.

Discussing the importance of Philadelphia as a textile centre with a representative of a large Lancashire firm of machinists engaged on erecting work in the city, the writer was informed that there is a large importation of yarns from Europe on account of the poor supply in America. Flax is sent from Ireland, jute from the Banks of the Garonne in France, silk from France and Switzerland, wool and worsted from England and Saxony, and hosiery from Germany and England. In his opinion English goods are better than American and German goods are cheaper. Speaking of the duty on goods he stated that if any increase were made on the 25 per cent. *ad valorem* duty on worsted, it would make little or no difference, as the American manufacturers must have them. He compared the wages of a weaver in Philadelphia (52/- to 64/- per week) with those in Lancashire towns, *e.g.*, at Padiham (20/- to 26/- per week), and considered that there was an opening for English workmen especially as carders or overlookers. His opinion was that the English workman is more tractable and inclined to be satisfied with his job, whereas his American brother is continually on the look-out for a better post. In the weaving of curtain damasks, etc., the yarns and threads are imported and woven in the States, owing to the improved machinery. He stated that the severe competition of American machinery is severely affecting Nottingham lace, although the latter is made from the best 240's Bolton yarns, out of Sea Island cotton. His own firm has already put up four mills (one of 80,000 spindles) in Philadelphia, a second mill of 140,000 spindles at Baltic, Connecticut, and another of 600,000 spindles at Fall River, Massachusetts.

Turning next to the consideration of the Textile schools of Massachusetts, we find a number of institutions built under

the stress of competition not only with foreign countries, but with the Southern States of America, the latter having a large supply of cheap coloured labourers. The competition of English mills in the finest grades of cotton, woollen and worsted goods has forced the Northern manufacturers to recognise the need of a more skilful and efficient staff of workmen, and the necessity for a supply of well educated manufacturers, engineers and inventors.

The first appeals of the manufacturers for financial help were successful, and in February, 1897, a school was started at Lowell, a city of about 95,000 inhabitants and one of the chief centres of the New England cotton industry. On January 1st, 1903, the school was transferred from the rented quarters occupied hitherto and placed in the new buildings which occupy a plot of ten acres of land on the bank of the Merrimack River, and overlooking the Pawtucket Falls. The Institute consists of three buildings: (1) Southwick Hall, the central portion of which—90 feet by 90 feet—contains three storeys, while the wings—80 feet by 85 feet—contain two storeys and a basement. (2) Kitson Hall, founded by the daughters of Richard Kitson of Lowell, is at right angles to the main portion, and consists of one storey and a basement, 60 feet by 252 feet. (3) The Falmouth Street building is 75 feet and 130 feet, and two storied. An extension containing three storeys and a basement, 70 feet by 80 feet, has recently been finished (Nov., 1903), and will be used for wool scouring, carbonising, conditioning, etc. There are departments for cotton spinning, woollen and worsted spinning, decorative art and textile design, chemistry and dyeing, finishing, power weaving, knitting, mechanical and electrical engineering. The machinery and plant have already cost £95,000 and are such as will enable the fibres to be treated in the school by every process until they become the woven fabric. To enumerate the machinery in the departments would be a tedious and lengthy process—suffice it to say it includes such well-known American and European makes as the Draper Co., of Hopedale (Mass.); G. S. Harwood, Boston (Mass.); Lowell Machine Shop, Lowell (Mass.); Crompton and Knowles, Worcester (Mass.); Hall and Stell, Keighley, England; Mather

and Platt, Salford, England. There are 37 hand looms and 34 power looms, including the Northrop, Whitin, Crompton, Knowles, and Lewiston patterns.

With regard to the course of instruction, all day students take common first term work and may then specialise in any one of the diploma courses, viz.: cotton manufacture, wool manufacture, designing, chemistry and dyeing, and weaving. Candidates for admission to the day classes are required to pass an examination in Arithmetic, English, Geography and Algebra.

The fee for the day course is £20 per year for residents in Massachusetts; for non-residents it is £30 per year. For evening courses the fees vary from 10s. to £2 per session. The evening classes are intended to give instruction to those engaged in mills during the day and to perfect their knowledge in the same or in allied subjects. The courses are: Cotton Spinning (three years); Woollen Spinning (one year); Worsted Spinning (two years); Design (three years); Chemistry and Dyeing (three years); Weaving (three years); Mechanical Engineering (two years). The award of a diploma at the end of the course stimulates the interest of the students, a fair proportion of whom graduate each session. Theses are presented on subjects connected with the textile industry, *e.g.*, "Comparison of effects of metallic and common rods on long staple cotton," "Relation of amount of twist to breaking strength of cotton yarn," "Sateen arrangement in textile fabrics," "Study of aniline blacks," etc.

During last session (1902–3) there were 120 day and 446 evening students, or (deducting names counted twice) a total of 537 individual students. Of these, 22 were taking the third year day course, and 36 were attending third year evening courses. The only criticism that may be passed on the curriculum is that it does not rest on a strong foundation of pure science, *e.g.*, mathematics and physics.

The influence of the Lowell Institute has been shown by the eagerness of the manufacturers to take "graduates" for the more responsible positions in the mills, and the mill workers who attend the evening courses have received practical

benefit resulting from quicker promotion. It is interesting to note that the labour unions were at first inclined to oppose the Textile Schools of Lowell and New Bedford, thinking that the wealthier day students would compete unfairly with the poorer workers who had to force their way to promotion in the mill. A labour union representative has recently been elected on the board of trustees and the opposition has been thereby diminished.

New Bedford, the seat of the New Bedford Textile School, is a growing city of 63,000 inhabitants. It has over 1,600,000 spindles and 30,000 looms, and is famous for its fine cotton yarns and fancy woven fabrics. The textile institute here, which was started in 1899, has now about 350 students, and a staff of 18 instructors. Recent additions have been made in the dyeing and chemistry and also in knitting, but the work is not yet on the same scale as the Lowell Institute. The income for 1902–3 was £6,600, and included an appropriation of £3,500 from the State of Massachusetts.

The fees for tuition in the day classes are £20 for residents in the States and £30 for non-residents.

Schools of Technology.

In order to understand the recent development of these high grade institutions of college rank, it is necessary to refer to the passing of the Morrill Land Grant Act of 1862. This Bill was first introduced in 1857, but after passing both Houses was vetoed by President Buchanan. It was again introduced when Abraham Lincoln occupied the presidential chair and successfully passed. The purpose of the Bill was to endow in each State at least one college whose object should be, "without excluding other classical and scientific studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such a manner as the legislature of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."* For the accomplishment of this purpose the Act granted to each State an amount of land equal to 30,000 acres for each Senator and Representative in Congress.

The amount of land thus granted for educational purposes was equal to one-fourth the whole area of England and Wales, or to the combined area of Denmark, Belgium and the Netherlands. New York State alone had no less than 900,000 acres; Pennsylvania had 790,000, and Ohio received 640,000 acres; Some 60 State colleges of mechanic, arts and agriculture have been founded under this Act, although in several cases the grant has gone to institutions mainly scientific or technological.

In March, 1887, a sum of £3,000 was granted to each State for the establishment and maintenance of agricultural experimental Stations connected with the Colleges, founded under the Land Grant Act. Further federal support was given on August 30th, 1890, by an Act which granted £3,000 to each State, this sum to be increased by £200 yearly for 10 years,

* Public Laws of the United States, 1862, Ch. 130.

after which the annual grant should be £5,000. The above Act further stipulated that the money should be applied to "instruction in agriculture, mechanic arts, English language, and the various branches of mathematical, physical, natural and economic science, with special reference to their application in industrial life." Cornell University receives the grant for the State of New York since it includes technical training in its curriculum. The Universities of California, Illinois, Minnesota, Wisconsin, and Michigan, all receive State grants from the above sources, and among the schools of Technology participating in its benefits are the Armour Institute, Iowa State College, Purdue University, Massachusetts Institute of Technology, and the North Carolina College of Agriculture. The total Federal Aid received in 1901 by the 65 State Colleges and Institutions amounted to £523,600, the total amount disbursed since the passing of the above Acts being £3,200,000.

Of the 42 institutes of technology, most of them might be termed Schools of Engineering, as the majority of the students are attending the various sub-divisions of mechanical, civil, electrical, chemical and textile engineering. The standard of work varies considerably, and probably some of them are inferior to the Manual Training Schools previously mentioned. Excluding from consideration the Service Academies at West Point and Annapolis, statistics are given of ten of the better class institutions, mostly situated in the North Atlantic and North Central States.

Six of the institutes are under private control, and four are under the control of the State. The Armour Institute, the Iowa State College and the Stevens Institute have preparatory departments containing 842 students, but, not counting these, there are in the ten specified Schools of Technology, over 500 instructors and 5,000 students, taking work equal to collegiate grades. The writer estimates that if the nine largest technical institutions of Germany, America and England are compared the results are as follows:—

The German institutions have a total staff of 1,137 and a student roll of 14,986. The American institutions have a staff

Particulars of Income.

	State or Municipal Sources.	Federal Sources.	Other Sources.	Total.	Control
	£	£	£	£	
Arnc	...	...	5,000	25,000	Private
Purd	20,200	8,000	1,930	39,930	State
Rose	...	...	...	9,400	Private
Iowa of Mc	5,000	8,000	570	21,220	State
Mass sti nol	5,000	1,670	7,400	73,570	State
Wor tec	1,200	...	...	14,300	Private
Steve	...	...	540	12,990	Private
Rens tec	...	...	30[b]	9,930[b]	Private
Case Sci					Private
Nortl Col cul Me	8,600	6,350	900	19,140	State

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STATISTICS OF SCHOOLS OF TECHNOLOGY, 1902.

Students.

Particulars of Income.

Institution.	Location.	Date of opening.	Number of Professors.	No. of Students. Men.	No. of Students. Women	Mechanical Engineering.	Civil Engineering.	Electrical Engineering.	Chemical Engineering.	Mining Engineering.	Tuition Fees.	Number of Scholarships.	Value of Apparatus.	Value of building.	Tuition Fees.	Funds.	State or Municipal Sources.	Federal Sources.	Other Sources.	Total.	Control
Armour Institute	Chicago (Ill.)	1893	43	686	33	87	56	140	41	...	£15	5	£ 60,000	£ 600,000	£ 12,000	£ 8,000	£ ...	£ .	£ 5,000	£ 25,000	Private
Purdue University	Lafayette (Ind.)	1874	81	1103	84	321	206	272	. .	...	Free to residents	...	62,400	76,800	6,400	3,400	20,200	8,000	1,930	39,930	State
Rose Polytechnic	Terra Haute (Ind.)	1883	20	164	0	48	32	59	16	.	£15	...	22,300	29,000	2,400	7,000	...	...	...	9,400	Private
Iowa State College of Agriculture & Mechanic Arts	Ames (Iowa)	1868	69	1216	204	91	119	163	...	15	Free to residents	...	22,400	112,000	...	7,650	5,000	8,000	570	21,220	State
Massachusetts Institute of Technology	Boston (Mass.)	1865	149	1366	49	129	162	96	30	76	£40[a]	122	79,000	289,000	46,500	13,000	5,000	1,670	7,400	73,570	State
Worcester Polytechnic	Worcester (Mass.)	1868	54	254	0	96	44	70	39	...	£30	65	27,000	100,000	6,100	7,000	1,200	...	..	14,300	Private
Stevens Institute	Hoboken New Jersey	1871	32	483	0	239[b]	..	...	...	..	£30 res. £45 non-res.	...	15,000	80,000	7,300	5,150	...	.	540	12,990	Private
Rensslaer Polytechnic	Troy (N. Y.)	1824	21	250	0	2	240	2	6	...	£40	...	13,000[b]	32,400[b]	8,260[b]	1,640[b]	...	...	30[b]	9,930[b]	Private
Case School of Science	Cleveland (Ohio)	1881	27	388	0	127	48	64	42	68 (Textile Engineering)	£20	40	(No Statistics given)								Private
North Carolina College of Agriculture and Mechanic Arts	West Raleigh (N. C.)	1889	30	369	0	155	32	58	11	41	£4	196	11,340	22,760	1,780	1,560	8,600	6,350	900	19,140	State

a. Includes electrical engineering.
b. Figures for year 1901.
c. Now £50

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In visiting these institutions the writer was struck by the great number of day students, most of whom would be over 17 years of age, and taking a regular three years' course, leading to the degree of Bachelor of Science (B.S.).

The machinery was of a larger size than is usually observed in European laboratories, the idea being to accustom the student to deal with actual trade conditions. It may be urged against the practice that such machinery is most difficult to handle, requires a large amount of power to keep it in motion, and when it falls out of date the renewal will prove rather expensive. Further, in the case of electrical machinery, a careless student may cause serious damage, both to himself and to the dynamo and motors. To the latter criticism the reply is made that the preliminary training on the smaller machines makes the students as competent as most workmen in an electric light station.

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The first place visited by the writer was the Stevens Institute, Hoboken, N.J., a school for mechanical engineering only, and founded in 1871 by Edwin A. Stevens, with an endowment fund of £100,000 and a building fund of £30,000. The late Principal—Henry Morton—contributed generously to the maintenance of the Institute during his term of office by gifts amounting to £29,000. The new Carnegie engineering laboratory has been built at a cost of £13,000, and Mr. Carnegie has given a further sum of £45,000 towards its endowment. A pleasing feature of this Institute is shown by the generosity of the alumni association in collecting £25,000 towards the provision of further accommodation. The writer noticed various fittings, *e.g.*, switchboards and dynamos, the gifts of students on leaving the school. This process of

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"handing on the torch of knowledge" indicates the high motives actuating the members of the class, and moreover is a testimonial to their interest in the work.

The curriculum offers a liberal education in engineering subjects, including mechanical drawing, machine construction, electrical engineering, workshop practice, engineering, chemistry, mathematics, physics, French, German, English and logic. Students are required to take the full course, which leads to the degree of Bachelor of Science.

Candidates for admission must be at least 17 years of age and must pass a stiff entrance examination in mathematics (arithmetic, algebra, geometry, trigonometry), English, literature, history, physics and chemistry. The standard of the examination is equal to that of an English university preliminary examination, and out of 200 applicants last summer 149 were admitted to the freshman course. In connection with the technical institute there is a Preparatory Department of High School Grade for boys between the ages of 14 and 18. The entrance scholarships include one for scholars of the Hoboken School; three for pupils of the Hoboken High School; one for pupils of the Hoboken Academy; and four awarded by the American Railway Master Mechanics' Association. In 1903 there were 118 first year students; 64, second year; 59 third year; and 50 fourth year students in attendance at the Stevens Institute.

Turning to the equipment of the various departments, the writer noticed advanced apparatus for optical and mechanical measurements, pure physics being taken in the second and fourth years for three hours theory and three hours laboratory. In electrical engineering the direct current work occupies the third year, and alternating current is studied in the fourth. A fine set of instruments have recently been presented by the Weston Instrument Co., Newark, N.J.; these include three damped millivoltmeters used as ballistic galvanometers or as magnetic-electric speed counters, also 18 voltmeters and a set of ammeters and standard cells.

For use as a lecture galvanometer the writer noticed a large millivoltmeter illuminated with two lamps and with a two-way

scale. Typed sheets of notes are handed to the students, who are given practice in the simultaneous working of problems on the blackboard, reminding one of the practice in elementary schools. For curve work one noticed the device of a blackboard ruled in squares and drilled with holes after the manner of a weaving blackboard. The machines, numbering 22, included a 2,400 volt two-phase machine, and a 500 volt direct current machine,—these were driven by a 25-h.p. steam engine, a gift of former students.

Complete sets of tests on fuels are made with the Mahler and Junker calorimeters, and pyrometer tests with the Le Chatelier element, nitrogen gas thermometer, and Uehling Steinbart recording pneumatic pyrometer; the students also make experiments on the analysis of flue gases with Uehling's comparator. In the testing laboratory are a three-ton transverse testing machine and a 50-ton machine for tension or compression tests. The writer noticed that in the steam engine laboratory the air, steam and exhaust pipes are all above the floor and in sight of the students, so as to show the different connecting points; in the experimental engineering laboratory the steel pillars supporting the girders are used for the passage of electric wires, gas pipes, warm air pipes, compressed air, etc.

This laboratory contains several types of machines, including an Otto Gas Engine, a Nash engine (dynamo driven), an air compressor (150 atmosphere pressure), and a 130-h.p. Corliss compound engine. Many of these machines are gifts from old students, *e.g.*, the 50-ton testing machine was presented by the class of 1901. As a means of keeping in touch with practical work the engineering class of 1902 made a tour of inspection to Schenectady, Niagara Falls, Buffalo, Franklin, Pittsburg, Altoona, and Philadelphia, 24 works and installations being visited. Similarly, in the fourth year the electrical students go for a ten-day visit of inspection to various cities, having previously received information concerning the plant and style of work to be observed.

The President of the Institute—Dr. Humphreys—strongly insists on the engineer being able to supervise the financial part of the work, and in the senior or graduating class lectures are

given on business engineering, including accounting, costing, law of contracts and science of statistics—the students being required to prepare a graduating thesis during the last term. Among last year's theses may be mentioned "The measurement of the efficiency of ammonia compressors in an ice plant," "Analysis of the progressive speed trial data of a screw ferry-boat," "Tests of boilers and air compressors on the power plant of the New York Subway," "Test of the boiler and engine plant of a city hospital," "Test of the Cahall and Babcock & Wilcox's boilers at a Long Island gas plant." These tests necessitate the students working on the various power plants in the neighbourhood, and it not infrequently happens that the pupil receives an offer from the firm whose machines he is engaged in testing.

The next institute visited was the Worcester Polytechnic in Worcester, a city of 119,000 inhabitants, located in Massachusetts and about 40 miles west of Boston. Worcester is the seat of the Roman Catholic College of the Holy Cross and also of the Clark University. Founded by a prominent citizen John Boyton, in 1865, the Worcester Polytechnic has now about 32 instructors and 248 students. Courses are offered in mechanical civil and electrical engineering, chemistry, and in general science, each of these courses taking four years, of which the first year (Freshman Course) is common to all. The degree of Bachelor of Science is conferred after the completion of any of the above courses; the student may spend one or two years' additional study preparing for the higher degrees of Master of Science and Doctor of Science. The degrees of Mechanical Engineer (M.E.), Civil Engineer (C.E.), and Electrical Engineer (E.E.), are given to graduates who have spent a certain number of years in the practice of their profession, and who present an original thesis.

Candidates for admission must be at least 16 years of age (as a matter of fact the average age of entrance is over 18), and are further required to pass an examination comprising United States history, English grammar, mathematics, English literature, and French or German.

The standard of English required from candidates in some of the better American Schools of Technology is higher than in the preliminary examination of an English University. For 1903 the required books for study were:

Shakespeare: Merchant of Venice, Macbeth, and Julius Cæsar.
Milton: Lycidas, Comus, L'Allegro and Il Penseroso.
Burke: Speech on the conciliation with America.
Macaulay: Essays on Milton and Addison.
Goldsmith: Vicar of Wakefield.
Coleridge: Rime of the Ancient Mariner.
Scott: Ivanhoe.
Carlyle: Essay on Burns.
Tennyson: The Princess.
Lowell: Vision of Sir Launful.
George Eliot: Silas Marner.

The above list, which is identical with the requirements for the New England College Entrance Examination Board, is certainly striking, and shows that as regards the teaching of English in the secondary schools, America has nothing to learn, the time devoted to this subject being made possible by the omission of Latin.

At the Worcester Polytechnic instruction is given by recitations and lectures, with laboratory and workshop practice; in the recitations the students are required to read up various topics chosen, and these topics are discussed with the Professor.

A striking feature of the curriculum is the large amount of time devoted to shop practice, the students being obliged to put in 200 hours at the end of the summer term, in addition to the usual period each week.

The buildings of the Institute comprise:

1. Boynton Hall — reserved for administrative offices, lecture and recitation rooms, library and museum.

2. The Washburn shops, founded by the Hon. Ichabod Washburn, of Worcester, for the training of the students alongside skilled workmen. Exclusive of the Foundry, the shops contain 33 rooms devoted to wood and metal work, and a

blacksmith's shop, washrooms, draughting and design rooms, painting and finishing rooms, stock rooms, etc.

3. The Salisbury Laboratories, the gift of the Hon. Stephen Salisbury, a four-storied building, 140 feet by 100 feet in size, devoted to Physics, Chemistry and Electrical Engineering.

4. The Engineering Laboratory, a three-storied building, 52 feet by 116 feet, containing a hydraulic laboratory, an erecting and testing laboratory, and a cement testing laboratory, also mechanical drawing-rooms and lecture-rooms.

5. The power laboratory containing three main steam engines, aggregating about 225-h.p., and a number of electric generators, including a 60-k.w. 500 volt Thomson-Ryan generator; a 75-k.w. 250 volt G.E.C. polyphase generator and a 30-k.w. 110 volt dynamo built by the Electron Manufacturing Co.

A high potential laboratory of 500,000 volts is situated near the entrance to the grounds, and the hydraulic testing plant is at Chaffinsville, some five miles distant from the Institute.

The Washburn shops are fitted up with a very complete set of machinery, and exemplify the practical character and high quality of American technical education. In the wood workshop the tools include 25 lathes varying from 9in. to 24 in. swing, nine circular saws, with an assortment of boring, mortising, and tenoning machines. A set of wood working tools from the best American manufacturers are kept on exhibition. In the machine shop there are 46 lathes varying from 15 in. to 30 in. swing; six upright drills of 14 in. to 36 in. swing; four drill grinders; five milling machines (including a Brown and Sharpe and a Cincinnati; four planers; two shapers; and various sets of Whitworth standard gauges, Pratt and Whitney standard threads, surface plates, etc. In the foundry are two cupola furnaces—24 in. by 32 in.; two crucible furnaces 24 in. and 22 in. respectively; one five-ton travelling crane; a core oven, 7 ft. by 6 ft. by 12 ft.; core and moulding machines, etc.

A beginning has been made of a permanent exhibit of the best American and foreign tools, arranged for the

inspection of students. The equipment of the engineering testing laboratory includes a 50-ton Emery machine for tension and compression; a 25-ton Fairbanks machine for tensile compression and torsion; a Riehle torsion testing machine; a cement testing machine, extensometers, viscometers, etc. In the boiler room the writer was informed that the coal was regularly weighed, the water measured and a complete daily log kept by the students. A 100-foot standard of length has been set up in the engineering laboratory and accurately graduated by reference to the U.S. Bureau of Standard Weights and Measures at Washington.

In the chemical department there are special laboratories for general chemistry, analytical chemistry, organic chemistry, industrial chemistry, sanitary chemistry, and gas analysis, the equipment in each case being most complete. The physics department contains many instruments of precision, including comparators, linear and circular dividing engines, catheto-meters, spectrometers, micrometer-microscopes, etc. In the electrical laboratory are various machines aggregating 800-h.p., also a number of special pieces of apparatus, including a 20 k.w. 150,000 volt transformer; a 75 k.w. 500,000 volt transformer; four small alternators showing any desired wave form; Reichanstalt photometers; Thomson balances; Weston, Whitney and Thomson ammeters and voltmeters, etc. It will thus be seen from the above description that the variety and excellence of the equipment is such that the student is given every opportunity of acquiring an accurate knowledge of his subject. It may be noted that in addition to entrance scholarships offered by the Education Committee of Worcester County, the State of Massachusetts awards 40 free scholarships, of which each senatorial district is entitled to one. As in other American institutions of a similar type, students work their way through by engaging in various forms of employment in the workshops. The students labour under trade conditions, and obtain practice in judging the relative importance of different parts of a machine from a journeyman's point of view. Forty workmen are employed altogether, and about 20 or 30 cwt. of metal is poured at a time in the foundry—only

light machinery being built. The students make the patterns and may possibly assist in the moulding. Amongst the machines turned out from the shops are wood trimmers, and wet drill grinders; in the woodwork department drawing models, adjustable drawing tables, catalogue files and cabinet work are exported, some of the machines being sold in England where there are several agents. In reply to an enquiry concerning working expenses, the manager of the shops assured the writer that no money was made out of the work—the students' work being sometimes unsatisfactory and having to be repeated—consequently the endowment fund only just meets the expenses. It may be interesting to note that the students put in their 200 hours in the workshops after the close of the term, consequently the vacation is curtailed both for students and instructors.

As in the Stevens Institute, the rule holds good at Worcester, that a thesis must be presented by all intending graduates and among the theses presented by the 44 students of the 1902 class, were the following:—

Student.	Title of Thesis.	Occupation of Student on leaving.
1.	"Relation of hardness to crushing strength in tool steels."	Instructor in Mechanical Engineering Laboratory, Worcester Polytechnic.
2.	"Construction of Artificial ice plant."	Instructor in Mechanical Laboratory, Pratt Institute, Brooklyn.
3.	"Abrasive and Grinding Machinery."	Foreman, Norton Emery Wheel Company.
4.	"Elastic properties of tempered steel."	With Spencer Wire Co.
5.	"Economy in the generation of power."	One Student Assistant Examiner U.S. Patent Office, another in Cost Department, Draper Co.
6.	"Design of freight and terminal yards."	Assistant Engineer, N.Y., O., and W.R.R.
7.	"Study of surface leakage on high potential insulating material."	One student instructor in electrical dept., another in Test Dept., General Electric Co.
8.	"Preparation of Beryllium oxide from Beryl."	Assistant Chemist, American Steel and Wire Co.

These results, chosen at random from the list of students,

indicate the extent to which the American manufacturers and engineers have recognised the value of men with a good practical and scientific training.

The Armour Institute at Chicago, which was visited by the writer early in December, 1903, proved interesting as a typical western institution. The rapid growth of Chicago which has now a population of 1,700,000, and second only to New York in point of size, is shown by the fact that the Armour Institute, founded by Mr. Philip Armour and built in 1893 at a cost of £600,000, has already extended its limits, with the result that a special building—Machinery Hall— has been erected recently. Even now the department of pure physics is carried on in some flats near the School, and the chemical department needs further laboratory accommodation. The Institute has a many-sided activity, including:

1. The College of Engineering, divided into Mechanical, Electrical, Civil, Chemical and Architecture.

2. The Armour Scientific Academy—a preparatory department of High School grade.

3. The Evening Classes.

4. The Summer School.

With regard to the school of architecture an alliance was formed in 1903 between the Armour Institute and the Art Institute of Chicago, by which the former furnishes instruction in the scientific branches, and the latter in the artistic and technical work. The classes at the Armour Institute are held in the morning, while the afternoon is devoted to drawing and architectural work at the Art Institute.

Courses have recently been established in telephone engineering and in fire protection engineering. The four years' course in the latter subject includes engineering work taken at the Institute together with technical work at the testing laboratories of the Chicago Underwriters' Association.

It is a rather grim commentary that in the city which started this novel scheme, with the approval and support of insurance architects, and business men, the necessity for such

protection should be emphasised by the occurrence of one of the most disastrous fires (viz., at the Iroquois Theatre) of recent years.

In the evening classes, which are rather unique for a school of technology, courses are given in Mathematics, Chemistry and the different branches of Engineering, the fees for each course being £6 a session. The influence of the Institute is exerted still further by an arrangement with the American School of Correspondence, whereby members of the staff of the Institute give instruction by correspondence to students preparing for the Freshman class.* Such extraneous duties would appear to be a heavy burden on the staff, who, presumably, will also be taking work in the evening classes and summer school, the latter alone being of five weeks' duration.

With regard to the requirements of admission to the Day Engineering courses of the Institute, the subjects for examination include mathematics, mechanical drawing, chemistry, physics, English, German (or Latin), and history; "graduates" of approved high schools are admitted without examination.

Through the courtesy of the founders' son, Mr. J. Ogden Armour, and the President and Dean of the Institute, the writer was enabled to make a detailed inspection of the building and equipment, which materially assisted in forming an idea of the sphere of work which is being carried out.

* In addition to Chicago University, correspondence courses are offered by the Pennsylvania State College and the State Normal Training School at Willimantic (Conn.). These correspondence schools have a legitimate field of work in catering for students who are engaged in occupations during the daytime and who are living in places far removed from any educational institution. For such students special instruction is given by the loan of scientific apparatus, text-books, and diagrams; in some cases the desire for study is simply a hobby or amusement, but in others there is a desire to gain information with a view to attaining better positions in life. Although the system lends itself to abuse in the hands of unscrupulous advertisers (one American correspondence school claims to teach typewriting, horse-shoeing, and electric wiring), the writer is convinced that it has many good qualities as a means of sustaining interest in intellectual work. The writer came across two English youths who had been on a ranch in Northern Canada, and whose only recreation during the winter evenings had been the study of building construction and architecture conducted by a large correspondence college; they expressed their admiration for the interesting manner in which the course had been presented.

The main building consists of five storeys and includes offices, lecture rooms, recitation rooms, library, laboratories (except the physical laboratory), and power house. The library† which is both central and departmental, has about 17,000 volumes of scientific and technical work, and contains a clock and oil paintings, the gifts of "Old Boys." Self-help is inculcated and students pay for tuition by service in the library from 5 p.m. to 7 p.m., or even by doing duty on the elevator. Altogether some 40 students are receiving free tuition in return for services as machinists, janitors, clerks, etc.

Instruction in the various departments is given by recitations, lectures and laboratory work. For the term examination in certain subjects, *e.g.*, electrical engineering, text books and notes are allowed because of the practical nature of the work.

In the laboratory work brief instructions are given and the student is required to work out his results and add a discussion as to their relation to allied sections of the subject—the whole forming a small thesis.

As a neat device in testing voltmeters and ammeters in the electrical department, the instruments were arranged on a special table and covered with a lid so that when not in use, the top could still be used as a bench. The hydraulic laboratory is equipped with a 4,000 gallon reservoir, a double suction centrifugal pump, a Pelton wheel, a pulsometer, a hydraulic ram and the usual weirs and measuring tanks.

In the testing laboratory is a 100-ton Riehlé, a 10-ton Riehlé, a 30-ton Olsen, and various machines for cement testing. The steam engine laboratory is equipped with a $9 \times 12 \times 24$ cross compound Corliss engine, fitted with double eccentrics; a 70-h.p. Russell automatic high speed engine; a

† The reader will no doubt have noticed the frequent references to the departmental libraries in institutions for higher education; the American authorities are quite aware of the value of municipal reference libraries, but for general class use a special library in the building is considered indispensible. The libraries in the pupil teachers' centres are splendidly organised, and are used by acting teachers who have been former students. In the institutes of technology the same care is spent on library equipment as on apparatus in the different departments, and with valuable results from the view of efficiency.

300-h.p. Ball and Wood engine; a Westinghouse automatic air brake system; a Christensen air brake system for electric cars, and complete apparatus for testing indicator gauges and thermometers.

In the gas engine laboratory there is a Fairbanks 7-h.p gas engine; a 7-h.p. Morse engine; a 20-h.p. two-cylinder double acting gas engine, and a Rider Ericsson hot air engine, etc., together with a collection of gas and fuel calorimeters. The new building known as Machinery Hall is four storeys in height with saw-tooth roof construction. The arrangement of the different workshops strikes the visitor as rather curious. The forge shop is on the first floor in order that the foundations of the steam and power hammers may be built up from the ground and also to allow room on the basement for the exhauster and blower for the down draught forges. The foundry is placed on the top floor to secure good lighting and reduce the height of the cupola stack. Each floor has its own lavatory, lockers, etc., and the lecture rooms are equipped for the nature of the work to be done, *e.g.*, the forge lecture room is fitted with an anvil and a down draught forge; the machine shop lecture room with a pattern lathe and bench. As in many American buildings the windows are made of ribbed wire glass. In the foundry there is a Whiting cupola of $1\frac{1}{2}$ tons capacity; a one-ton overhead travelling crane with pneumatic hoist to carry the molten metal in the truck ladle and run it into hand ladles. The students were engaged in making castings for a lathe bed and for snap flask stalls; some brass castings for steam engines were also in operation. The number of students attending the classes in moulding was about 180.

In the pattern shop there were some 36 pattern lathes and a set of band saws, planers, rip saws, mortisers, and tenoners, all worked by electric motors, the shavings being exhausted automatically.

In the machine shop the students had just completed a small 6 in. × 8 in. reciprocating steam engine, also a 30 in. planer, and were preparing to work on the lathe castings mentioned above. All pipes in the machine shop under 6 in. in

size have been cut, fitted and set in position by the members of the engineering classes. The equipment of the department includes 14 lathes varying from 12 in. to 36 in., three shapers, three 13in. milling machines, four speed lathes, grinders, power drills, and automatic screw machines.

The dynamo laboratory was fitted with 20 machines, the direct alternating current including a 45-k.w. 60 cycle single-phase 1,100 volt machine; a 25-k.w. 133 cycle single-phase 1,100 volts; a 15-k.w. rotary converter two and three phase, 25 cycle; a 15-k.w. 60 cycle 1, 2, 3, and 6 phase alternater; a switchboard for high tension work, direct current work, three phase work, and for the 25 cycle apparatus. The twenty transformers of Weston or Westinghouse patterns include six 5-k.w. 25 cycle, single phase; one, 40,000 volt, and one, 50,000 volt, the remainder varying from 1 to 18-k.w. The professor mentioned the difficulty of vibration arising from two railways—the Rock Island and the Lake Shore and Wabash Lines,—which run past the institute, and thereby necessitating galvanometers suspended from the ceiling by a double spiral spring For taking up the load on the dynamos water cooled carbon rods arranged in series were used. The Physics Laboratory contained some apparatus purchased at the Chicago Exhibition including dividing engines, cathetometers, recording chronographs, a six foot grating and various types of spectrometers and spectroscopes. Unfortunately some of the apparatus for advanced work was hardly receiving fair treatment owing to the cramped space in the temporary premises opposite the school.

The Chemical Department has four laboratories for the Academic, Freshman, Sophomore, and for the Junior and Senior Courses. The total number of students taking this course is about 450, excluding 40 students who are not taking laboratory work; in the writer's opinion the laboratories were badly ventilated, the ceiling being too low, and there being too many students in at one time.

In addition to workshop practice, the senior engineering students are divided into sections under a competent engineer and they take charge of the Institute power plant including the electric lighting, electric and hydraulic elevators, steam

heating and hydraulic apparatus. Considering that the output of the engines for power purposes is 400-h.p., and that of the boilers for heating and power is 1,100-h.p., the students gain valuable practice in central station work and are quite capable of taking charge of small power plants when they finish the course. Several of the 1902 class were engaged by the General Electric Company and the Westinghouse Electric Company; two women graduated in architecture in 1902, one of them being engaged with a firm of architects in Chicago and another woman who graduated in the class of 1900 in civil engineering is at present engaged with a firm of structural engineers in the same city.

The three technological institutes already described, viz.: Stevens, Worcester and Armour, are of private foundation, and it may be useful to compare with them some of the State Institutes, such as those maintained by the States of Massachusetts, Indiana, and Iowa, all of which have a good reputation, the first-named of course being the finest institution of its class. All three receive grants from state and federal sources, but whereas the Massachusetts Institute charges fees (£40 per annum) the other two offer free tuition to residents in their respective States. The result has been a large growth in the number of students, the Indiana institution having in three years increased by over 80 per cent., and the question has arisen whether the entrance requirements and fees to non-residents should not be increased so as to limit the numbers.

The institution at La Fayette, Indiana, was started as a result of the Land Grant Act of 1862, the name Purdue University being given on account of the generous gift of £30,000 towards its maintenance by Mr. John Purdue—Cornell University being another case in which the name has been associated with the gift of the founder. The Purdue University offers courses of instruction in Agriculture, Applied Science (Biology, Chemistry, Physics, Industrial Art, and Sanitary Science), Mechanical Engineering, Civil Engineering, Electrical Engineering and Pharmacy. In addition there is an Agricultural Experiment Station, which receives a Federal grant of £5,000 annually for conducting experiments in agriculture.

The institution has now 92 professors, and 1,340 students, the latter including 54 post graduates and 72 taking a winter course in agriculture. To meet the demand for increased space the State of Indiana has recently passed an Act to increase the State Educational Tax from $^1/_{20}$ mill. to $^1/_{10}$ mill. on each dollar of taxable property. Further appropriations amounting to £20,000 have been made for the purpose of erecting a new Physics building, a central light and power station, and for the equipment of the School of Agriculture.

Candidates for admission to the Freshman Class must be at least 16 years of age and must pass an examination in English, Algebra, Plane Geometry, and one selected subject from the following:—History, Science, Modern Language, Latin. A graduate of an approved high school of Indiana is excused the examination.

An applicant for admission over twenty-three years of age, who has served a regular industrial apprenticesip or who has had training along the line of the practical work of the course he wishes to enter, may be excused from examination in the selected subject.

A limited number of the students support themselves whilst studying by assisting in the construction of tools and appliances or in the care of live stock and in harvesting. Although the equipment of the building is not so fine as some of the other institutions previously mentioned, nevertheless there are some distinct and interesting features. The Baldwin Locomotive Works of Philadelphia have presented the engines of an actual locomotive mounted on a fixed foundation as a stationary engine; the two high-pressure cylinders are 16in. diameter, the stroke in all being 18 inches.

The testing plant admits of a locomotive being brought into the shed and mounted on supporting wheels carried by shafting running in fixed bearings to receive the locomotive drivers and turn with them. Brakes are mounted upon the shafts of the supporting wheels and have sufficient capacity to absorb continuously the maximum power of the locomotive. A traction dynamometer indicates the pulling force of the locomotive and in addition there is a Boyer speed

recorder, three other indicators and a Le Chatelier pyrometer. The testing shed is in direct connection with the Lake Erie and Western Railroad. The Institute also possesses a locomotive made by the Schenectady Locomotive Works, weight 50 tons, with 69 in. drivers, 250 lbs. pressure in the boiler, and with cylinder arranged for single or compound working. A brake-shoe testing machine and an air-brake testing rack have been presented by the American Master Car Builders' Association. As a nucleus for a locomotive museum the Institute possesses three locomotives—an 8-wheel type, a "camel-back" type, and an English type, together with specimens of typical railroad cars, brake beams, car couplers, truck bolsters and other appliances.

In the department of Agriculture the dairy laboratory is fitted with separators, churns, cream refiners, skim milk weighers, butter workers, cream balances, etc. The Live Stock Farm is used for two purposes, viz., class-room work for judging types and breeds, and for experiment. The cattle include a herd of 30 head of Shorthorns, Herefords, Jerseys; the sheep consist of two breeds, Shropshire and Merino, numbering about 40 head in all; there are also four breeds of swine, viz., Poland China, Berkshire, Cheshire, and Yorkshire.

The department of Agriculture has also a horticultural laboratory, a veterinary laboratory and an agricultural library and museum.

The Iowa State College at Ames, Iowa, is worked on the same lines as the Purdue University but has a prominent Department of Agriculture. Situated in the fertile district between the Mississippi and Missouri Rivers and having four-fifths of its area covered with prairie which forms excellent pasturage for cattle, Iowa occupies an excellent position for cattle rearing and dairy farming. It has also 18,000 square miles of coalfields with occasional deposits of clay and limestone, the Eastern portion of the State being rich in minerals.

The College offers courses in Agriculture (Agronomy, Dairying, Animal Husbandry, and Horticulture), Veterinary Medicine, Mechanical, Civil, Mining and Electrical Engineering, Industrial Science and Domestic Science. On the

completion of the above courses degrees are awarded, viz.:— B.S.A., D.V.M., B.M.E., B.C.E., B.Sc. in E.E., B.Sc. in Min. E., and plain B.Sc. It strikes an observer as an unnecessary duplication to have more than the B.Sc. degree except in Veterinary Medicine. Among the degrees given for post-graduate work are those of M.S.A., M.S., M.E., E.E., C.E., and E.M., so that the student has a fair amount of choice. Candidates for admission to the College must pass an examination in geography, arithmetic, history, physiology, English, algebra. The standard is not high and some of the questions, notably in mathematics, are of a very artificial character.

As the instruction is provided free to all residents of Iowa there is a great influx of students to the College, many of whom are not sufficiently prepared to take advantage of the classes. The U.S. Government contributes £7,000 each year for original experimentation and instruction in agriculture. Among the points of interest may be mentioned a Live Stock room into which animals are brought in the presence of the instructor and class for careful study. There are special short courses of two week's duration in corn judging and grain judging for the farmers in the State—in the words of the Calendar the trophies consist of "a prize of £20 for the Grand Champion Sweepstake ear of corn" and "a prize of £20 for the Grand Champion sample 10 ears of corn."

The Department of Dairying offers instruction in milk-testing, cheesemaking, buttermaking, and factory management; there is even a course in the preparation of ices and ice cream. A Chicago firm of Live Stock Commission Agents offers £200 in prizes to be awarded to the agricultural Colleges making the best exhibit of live stock at the International Live Stock Exhibition.

The department of Engineering is well equipped with a supply of testing machines, including an eight-wheel passenger locomotive and tender presented by the Chicago and North Western Railway, and mounted for experimental work.

In connection with the Department of Civil Engineering the professors and students go into camp for 15 days in the

summer and conduct an organised topographical survey of some region in the State, a fresh area being mapped each year. A similar course is carried out with the department of Mining Engineering in the Iowa coalfields.

A certain number of the students who require financial help are engaged in harvesting and the care of the live stock as in the experimental station, some £800 per annum being paid out in this manner. The students are further enjoined to study elocution and oratory which consists in "lectures on physical and vocal expression, gesture, and supplementary topics, more formidable recitation and declamation, criticism and coaching the students on the floor"—to quote the calendar.

Turning now from the Western State Schools of Technology to the study of a typical eastern Institution, viz., the Massachusetts Institute of Technology, one is struck with the great difference both in the general breadth of knowledge and the high standard of scholarship shown.

In size Massachusetts is one of the smallest States in the Union, being only one-sixth the area of Pennsylvania and one-seventh that of Iowa or Illinois. Its total area is equal to the combined area of Lancashire and Yorkshire; its population is equal to the population of Lancashire and its chief town, Boston, has a population (561,900) slightly exceeding that of Manchester. Although its population is exceeded by the States of New York, Pennsylvania, and Illinois yet in educational matters it takes a leading position. In the statistics of the Bureau of Education for 1901–2 Massachusetts came out top for the number of city school systems, the number of school buildings, the average attendance and the value of school property, and it raises $2\frac{1}{3}$ million pounds annually for educational purposes, which works out at the rate of £7. 16s. 6d. for each pupil in attendance (elementary and secondary schools included). The technological institute at Worcester; the horological school at Waltham; the textile schools at Lowell, New Bedford, and Fall River, together with the Boston Institute of Technology, Clark University at Worcester, and Harvard University at Cambridge offer a combination of educational facilities unequalled by any other State in America.

UNIVERSITY OF CALIFORNIA

The Massachusetts Institute of Technology, at Boston, was founded under the Land Grant Act of 1862 and is supported partly by fees, partly by State and Federal grants, and partly by the income from endowments. The cost of tuition is large, viz., £50 per annum, but a number of scholarships are offered, including 40 awarded by the State of Massachusetts. The age for admission to the Freshman class is 17 years, although the average age of the 420 students who entered in 1902 was 18 years and 10 months. Candidates for admission must pass an examination in algebra, plane geometry, solid geometry, French, German, English, history, and one of the following:— French or German (advanced), Latin, English (advanced), History (advanced), Physics, Chemistry, Mechanical Drawing. It is probable that in 1905 Physics may be added to the list of compulsory subjects.

The growth of the institute may be inferred from the attendance of over 1,000 day students, including 160 graduates of various other institutions; of the latter 12 are from Yale University and 12 from Harvard University. The teaching staff numbers 171 and includes 21 professors and instructors in mechanical engineering; 31 in chemistry, and four in naval architecture. In addition to the above systematic lecturers there is a staff of trade experts numbering 39, who deliver lectures on special subjects, *e.g.*, in 1902 a State gas inspector delivered lectures on "The Manufacture of Illuminating Gas"; the general manager of a chemical company upon "Aluminium Compounds"; the superintendent of the Boston Rubber Shoe Company, upon "Rubber"; the electrician of the Boston and Albany Railway, upon "The Application of Electricity to Railroad Working"; a State hydrographer, on "Irrigation," and in this way the question of acquiring practical knowledge to test the theory is never lost sight of. The advanced engineering students are given opportunities of running the locomotives of the Baltimore and Ohio Railroad, Boston and Maine Railroad, and other lines, the "log" of the run being taken and the various efficiencies worked out. Last year the four horizontal multitubular boilers were tested day and night for five days, the students working in eight-hour shifts. In the department

of civil engineering, instruction in geodesy and astronomy is given in a small observatory near Boston, equipped with a $2\frac{1}{2}$ in. transit instrument, sidereal chronometer, chronograph, magnetometer, altazimuth instrument, etc. By the same students an actual railroad survey, several miles in length, is made each year and the necessary maps and profiles are worked out. Practical work in the naval architecture classes is carried out at the U.S. Navy Yard and at the yard of the Fore River Ship and Engine Co., making it possible to arrange for speed trials and tests of engines and boilers. In 1902 the Mining Engineering class attended a summer course in Novia Scotia and Cape Breton for the purpose of studying the gold mining, coal mining, iron blast furnaces and open-hearth steel plants in that neighbourhood.

Perhaps the most striking part of the curriculum is the amount of literary, historical and economic study taken by the students of the first three years; during the summer vacation the first and second year students are given a list of books on science and general literature for study—the amount actually read to be reported in October.

The Institute offers thirteen distinct undergraduate courses, each of four years' duration, viz.:—

1. Civil Engineering.
2. Mechanical Engineering.
3. Mining Engineering and Metallurgy.
4. Architecture.
5. Chemistry.
6. Electrical Engineering.
7. Biology.
8. Physics.
9. General Studies.
10. Chemical Engineering.
11. Sanitary Engineering.
12. Geology.
13. Naval Architecture.

The different departments occupy no less than seven buildings, viz.: The Rogers Building on Boylston Street, devoted

to mining engineering, mathematics, etc., and containing the administrative offices; the Walker Building on Boylston Street, devoted to Chemistry and Physics; the engineering laboratories in Trinity Place, devoted to departments of Mechanical engineering and Naval architecture; the new Pierce building occupied by the departments of architecture, biology, geology, and industrial chemistry; a series of mechanical laboratories on Garrison Street, and the Lowell Building on Clarendon Street (recently built at a cost of £14,000), used for Electrical Engineering.

Owing to the large increase in the number of students (in the year 1900 there were 1178, in the year 1903 there were 1608) anxiety has been felt for the work of carrying on the classes in several buildings bordering on the main thoroughfare of Boston and which have nearly reached their limit for further expansion. One suggestion is to transfer the whole Institute to a more open position, where a system of student houses similar to English University houses may be built. By this means the cost of tuition and living would be lowered so as to allow the sons of men with small incomes to receive the benefit of an education which at present is becoming beyond their limits. The relations between the Massachusetts Institute and the neighbouring Harvard University are most friendly, the latter supplying instructors to the Institute for the classes in Geology and Climatology. On the other hand the University has recently added a laboratory for Electrical and Mechanical Engineering in the Lawrence Scientific School, the idea being to afford instruction in every branch of Science and to keep in touch with the recent developments of the age.

In paying a visit of inspection to the Institute of Technology, the writer noticed the advanced work being done in the departments of mechanical and electrical engineering, and chemistry. The Chemical Department alone contains 25 laboratories, three lecture rooms, a reading room, library and balance room; five new laboratories have recently been added for research work. The laboratory for inorganic chemistry accommodates 600 students, and is equipped for elementary work; the analytical laboratories accommodate 200 students, and there are

other laboratories for organic analysis, water, air, and food analysis. The new laboratories for industrial chemistry accommodate 48 students; on the lower floor is a store room, instrument shop, undergraduate recitation room, and lecture room; on the upper floor are a number of research laboratories for physical chemistry, each holding two students. In the first there was a research on rare metals proceeding; the second contained some work on the solubilities of substances; two others were devoted to high temperature work, viz., the conductivity of water solutions at 300°—a rather difficult problem on account of the high pressure obtained. There was also an investigation on dielectric constants at high temperature. The fifth room was used as a chemical supply room, containing a special water "still" built for conductivity purposes, the water only having $^1/_{10}$th the ordinary conductivity value. A sixth room was used for optical work, a seventh for a research on the conductivity of fused salts, while yet another was engaged by a member of the staff for a special research on colloids undertaken at the request of the General Electric Company of Schenectady. The remaining space was devoted to balance rooms, and undergraduate work. This new laboratory, though only recently started, has already a reputation equal to that of some of the best American University laboratories. In the same Pierce building is a finely equipped department for mineralogy containing a wide range of specimens and models.

In the mining engineering department the instruction is divided into five parts, viz., concentration, lixiviating and amalgamating, smelting, assaying, and the microscopical examination of ores. The laboratory is fitted with ore-breakers, rolls and stamps, jigs, revolving and Wilfley tables, vanners, and magnetic machines; also furnaces for roasting and smelting copper and lead, and for assay work. The Departments of Civil and mechanical engineering carry on a three-cornered contest with the corresponding laboratories of Cornell and McGill Universities, and the opinion of the visitor who has seen the latter institutions is therefore freely canvassed.

Examining these laboratories in detail the special Heat Laboratory contains all kinds of apparatus for the measurement

of fuel efficiency, including the Mahler, Parr and Berthelot methods. Calcium carbide is made, analysed in a Lunge apparatus, and the acetylene tested for efficiency. The professor of this department has recently been investigating the calorific value of various "briquettes" and substitutes for coal, including combustible mud obtained from certain classes of bog land. The research was occasioned by the shortage of fuel during the coal strike in 1902 and the results indicate a large supply of hitherto untapped material with a fair heat efficiency. The aim of the equipment in the laboratories is to carry on original research of real value to the engineering profession in addition to the ordinary work of instruction, and the completeness of the equipment certainly gives every opportunity of so doing.

In the Applied Mechanics Laboratory is an Emery testing machine of 300,000 pounds capacity; another of 100,000 pounds, and a third of 50,000 pounds for testing tensile strength and elasticity; a 50-ton machine for testing beams up to 25 feet in length; an apparatus for testing the strength of full-sized masonry arches; a machine for testing the torsional strength of shafting up to 3in. in diameter and 21ft. in length; a machine for testing the effect of repeated stresses and strains upon the elasticity of iron and steel; and an instrument for testing the strength of ropes, sail cloth, and chains.

Special attention is paid to cement testing, specimens being made in moulds and hammered with stamps operated by cams and with a definite length of stroke delivered at constant pressure. In order to obtain a homogeneous specimen there is a special mixing machine which imitates the manual operations, curved blades taking the place of a trowel, and metal rods replacing the fingers. The Hydraulic laboratory contains a 48in. Pelton wheel, of 30 h.p.; a 3-foot impulse wheel; a Venturi meter; a 6in. turbine; a hydraulic ram, also various orifices, nozzles and diaphragms capable of insertion in a closed steel tank, 5ft. diameter and 27 feet high, to study the effect on the discharge.

The Steam Laboratories contain a 150-h.p. triple expansion Corliss engine; a 275-h.p. high speed, tandem compound engine, provided with surface condenser, air pump, etc.; a three-stage

air compressor, compressing 100 cubic feet of air per minute to a pressure of 25,000 lbs., per square inch, and stored in steel tubes where the efflux through orifices is determined by Fliegner's method. There is also an equipment of Westinghouse air brakes for freight cars, used to determine the effect of moisture, etc. The workshops are provided with 36 wood lathes, 23 engine lathes, and 17 hand lathes, also shapers, planers, machine drills, etc.

The latest addition to the Massachusetts Institute is the new Lowell Laboratory of electrical engineering which covers an area of 45,000 square feet and contains a main power and testing laboratory, 300 feet by 40 feet, and lecture rooms, photometer room and research rooms. The plant is equal to a fair-sized central station, the boiler capacity already installed being 500 h.p. and the total output of the laboratory (including current driven machines) being 1200 h.p. The power plant consists of a 480 k.w. direct current set; a 150 k.w. 3-phase set; two 75 k.w. D.C. machines and two 25 k.w. machines, driven by a single engine. The motor-driven units include a 100 k.w. 3-phase 60 cycle dynamo; a 50 k.w. 25 cycle, 3-phase machine; a 125 k.w. 500-volt D.C. machine. There are a number of smaller machines varying from 1 to 30 k.w. For moving the various loose machines, a 10-ton overhead crane is used.

The main lecture room with a seating capacity of 300, contains a heavy oak lecture table, sliding on rails, so that it can be moved bodily into the preparation room and replaced by a second similar table for the next lecture. The arrangement for arc lamp photometry is especially complete. An interesting feature of each department of the institute is the library—"the finest piece of apparatus in the laboratory," as one professor remarked.

In 1902 there were no less than 63 women in attendance at the Institute; of this number four were graduates of colleges, and seven were taking the fourth year regular course. Thirty devoted themselves to Biology, and five were taking the four-year course in Architecture.

The wide area from which the Massachusetts Institute draws its students is shown by the fact that in the year 1902

only 58 per cent. (935) were students of that State. Of the remainder, New York supplied 96, Illinois 49, Pennsylvania 44, Ohio 43, and Connecticut 43. No less than 47 are from other countries, including 10 from Mexico, nine from Nova Scotia, five from Brazil and three from England. Of the 193 students who graduated in 1902, 46 studied mechanical engineering; 35 Electrical Engineering; 24 Civil Engineering, 18 Architecture, and 14 Naval Architecture.

The American employer of labour is fully aware of the calibre of these students, and the following list shows the present occupation of twelve chosen at random from the graduating class of 1902.

Student.	Title of Graduating Thesis.	Occupation of Student.
1.	"Steam consumption tests on a Westinghouse Parsons Steam Turbine."	Boat Department, Riter-Conley Manufacturing Co., Pittsburg.
2.	"Steel frame for Office building."	Carnegie Steel Co.
3.	"Action of metals on certain Ketone chlorides."	Research Laboratory, General Electric Co.
4.	"Efficiency test of 300 H.P. De Laval Steam Turbine."	Draper Co., Hopedale, Mass.
5.	"Comparison of methods of testing static transformers."	General Electric Co.
6.	"Investigation of the launching of a steam yacht."	U. S. Navy Department.
7.	"Design for railroad between Lexington and Waltham.	Maintenance of Way Department, Baltimore and Ohio Railway.
8.	"Tests on pulsometer pump."	American Loco. Works.
9.	"Design for the foundations of a heavy building."	Assistant Engineer, Rapid Transit Subway Construction Co., New York.
10.	"Calculations on train resistance."	Test Department, Southern Pacific Railway.
11.	"Duty trial on Worthington pumping engine at Lowell, Mass."	Fore River Ship and Engine Co., Boston.
12.	"Tests on a pneumatic boring machine.	Ingersoll-Sergeant Drill Co.

Attitude of American Employers of Labour Towards Trade and Technical Education.

As an appendix to the description of American technical education there is given below the opinion of the various trades with respect to the suitability of highly trained workmen. The writer is indebted to the various firms mentioned for permission to reproduce the information collected.

Building Trades. It is the opinion of experienced employers of labour that the trade education of their journeymen leaves much to be desired. The labour unions compel apprentices to serve for a number of years and the wages are to a great extent regulated by these same unions. Nevertheless the young men who attend trade classes such as are held at the Boston and New York Trade Schools, receive higher remuneration and make quicker progress than those who have not had the advantage of this training. The master builders and master plumbers are always ready to acknowledge the necessity of studying scientific principles and sanitary laws, in order to keep up with the rapid development of their trades.

Car Building. Opinions in this industry are undergoing a great change. Some of the larger western firms, *e.g.*, the Pullman Car Company, of Chicago, have no system of apprenticeship and only take on fully qualified journeymen. Further, they consider that the men should first of all be good mechanics, and this can only be learnt by shop practice. On the other hand the Eastern firms have afforded special training to foremen and mechanics engaged in the trade. In reply to an enquiry of the writer, the American Car and Foundry Company of New York replied as follows: "We are most enthusiastically in favour of college-trained men. We find that after they arrive at a point where they realise their deficiencies, they develop rapidly in all directions and quickly

out-distance the man who has not had the benefit of technical training. We thoroughly believe in college and technical schools training their men along practical as well as theoretical lines. There are several institutions in this country which combine both, and we find that men coming from these places are well equipped to take up almost any kind of work."

Chemical and Dyeing Industry. There is a great demand in America for trained chemists in steel works, gas works, electro-chemical works, and dye works. Special courses in chemical engineering are found in most colleges and technical institutes. The large steel plants at Pittsburg and the Pennsylvania oil works employ many German and American chemists. The rapid development of the electro-chemical industry has increased the demand for properly trained men possessing a high knowledge of chemistry, electricity and engineering. Among these works may be cited the Willson Aluminium Company of Virginia (manufacturers of ferro-chromium) and the various firms at Niagra Falls manufacturing caustic soda, aluminium, carborundum and fused alumina.

In the dyeing trade not only are trained chemists required, but, what is equally important, a staff of trained designers, since a novel set of designs will often mean financial success to a firm. Although the manufacturers prefer self-trained designers, a man who has had an artistic training in the "Schools of Design" similar to the Lowell and Philadelphia institutions, and who, in addition, has put in a period of training as a finisher, can always command a good salary and his services are eagerly sought after. The same remark applies to the wall-paper and furniture trades.

Engineering Trades. The opinions of the establishments engaged in the trade—a trade in which America is rapidly occupying a commanding position—are generally in favour of some kind of technical education for their workmen. In many cases the employers report a distinct improvement in the quality and character of the work turned out by men studying at evening classes or in correspondence classes. A few of the more conservative firms state that they prefer shop-trained men only:

e.g., the firm of Pratt and Whitney, machinists, of Hartford (Conn.), who employ about 1,100 men, replied to an enquiry as follows:—

"Although a suitable college or technical training assists a certain class of our apprentices yet education, although assisting, does not make brains, and our work is largely routine work requiring the highest grade of mechanical skill but involving no problems of a scientific nature. We do not overlook the fact, of course, that the training of the mind in College is a benefit and from among our young men we want our future managers, salesmen and the like, but the college graduate is often above the drudgery of going through the work, and it is only by going through works thoroughly and learning by actual contact the details of every operation that a man becomes a good shop man." The Cincinnati Planer Co., a large machine firm in Cincinnati, Ohio, say they have not had much experience of college-trained men, "who often fail to understand the value of time." On the other hand, the firm admit that "such education makes these men capable of readily grasping new ideas, and suggestions, and of making good use of the same." The R. K. Le Blond Machine Tool Co., of Cincinnati, make an allowance of one year for scholars who have attended a technical school for a period of two years. The Allis-Chalmers Co., of Milwaukee, Wisconsin, a large firm of engineers, have recently instituted the practice of admitting college trained men for a two year apprenticeship, the young men receiving a higher rate of pay and a bonus on the expiration of the time. The firm further state that "whenever good technical training and executive ability are combined in college graduates such men can unquestionably be trusted with any position of responsibility." The firm of Brown and Sharpe, toolmakers, of Providence (R.I.), compel all their apprentices to take the evening classes of the School of Design in Providence, or join certain correspondence school classes. Graduates of the Providence Manual Training School have their term of apprenticeship shortened. The company maintains a circulating library of technical works to assist the apprentices in their studies, and for a period of

one hour a fortnight the apprentices attend a lecture or discussion on subjects bearing upon the trade.

In the writer's opinion the apprenticeship system in America is in a very loose state—more so than in England—but the more up-to-date firms are reorganising their systems, so as to create different classes of apprentices for different positions in the works. Such a plan is in operation at the Baldwin Loco Works, Philadelphia; the General Electric Company at Schnectady; and the Westinghouse Electric Co. of Pittsburg.

The Baldwin Loco Works employ about 12,000 men, of whom some 800 are apprentices. These apprentices are arranged in three classes, viz.:—

First Class apprentices—17 years of age—serving 4 years, and who are obliged to attend evening classes for three years, viz.:

In the 1st. year—Mathematics.

In the 2nd. and 3rd. year—Mechanical Drawing.

The *Second Class* apprentices are of the same age but are supposed to have received a high school training. They are required to attend evening classes in mechanical drawing for two years. Time of serving—4 years.

The *Third Class* consists of graduates of technical schools and colleges who have had a good technical education and have attained the age of 21. These men serve two years.

The rates of pay are as follows:—

	1st year.	2nd year.	3rd year.	4th year.
First Class	5c. per hour.	7c. per hour.	9c. per hour.	11c. per hour.
Second Class ...	7c. ,,	9c. ,,	11c. ,,	..
Third Class	1st 6 months ... ... 13c. per hour.			
	2nd 6 months ... ... 16c. ,,			
	3rd 6 months ... ... 18c. ,,			
	4th 6 months ... ... 20c. ,,			

At the expiration of their time the first-class apprentices receive a bonus of £6. 5s. 0d., and the second-class one of £5.

As may be expected, the need for trained men is greatest in the testing department of the larger electric works, and every inducement is offered to such men. In the Testing Department of the General Electric Co. at Schnectady no less than 300 men are graduates of college and technical institutes, including 40 from foreign schools. These men must be at least 21 years of age, and after remaining 12 to 18 months in the test department they are eligible for positions in the Engineering or Commercial Departments, and may secure appointments on the installations of the Company's customers.

The Westinghouse Electric Company of Pittsburg have a special two-year apprenticeship system for graduates of technical schools or colleges (Cornell University, Massachusetts Institute of Technology, Stevens Institute of Technology, &c.), and at present there are about 150 young men taking this course. The manager assured the writer that "the company must, in the future, look to the college-trained apprentices for its future salesmen, construction engineers, designers and for other positions requiring brains." Lectures, both technical and general, are delivered at the "Electric Club," which is an organisation for the physical, mental and social recreation of the apprentices.

In addition to the above action on the part of the American engineering firms, the railroad companies are equally alive to the importance of the trained specialist, the Pennsylvania R.R., the Baltimore and Ohio R.R., and the Illinois Central R.R. being striking examples.

From a perusal of the foregoing account it is evident there is a fairly good concordat between the technical schools and the employers of labour, the former turning out pupils who, during their period of training constantly keep in view the future commercial application of their knowledge, the latter receiving the products of the schools, and offering the young men every opportunity for rapid advancement.

This part of American education connected with trades

and commerce, is one in which, until recently, the English educational system was weakest but we may congratulate ourselves on the awakening of public opinion to the unsatisfactory nature of our position in that respect. Within the last few years an increasing amount of expenditure on technical education has taken place and local authorities have not been backward in planning new institutions for the instruction of trade apprentices and students. The completion of the Manchester Institute of Technology is a landmark in the educational history of that city; large new technical schools are now being built in Bolton and Glasgow; while the technical institutes of Belfast, Warrington, Hackney and Paddington have already started on their respective careers. Further, the employers of labour are beginning to see the value of such institutions and to encourage the higher education of their workmen. In the case of the larger engineering firms in Great Britain the general opinion seems to be in favour of a "sandwich" system of education whereby the apprentices may attend the day technical college or university in the winter months and spend their time in the works during the summer. Such a scheme, which would suffice for the training of the heads of departments and chief designers, is already in operation in many firms, including the North British Railway Company (Glasgow); Vickers Sons and Maxim; Messrs. Yarrow and Co.; J. J. Thorneycroft and Co; British Westinghouse Co. (Manchester); Armstrong Whitworth and Co. (Newcastle); and Palmers (Yarrow). In Germany the intending engineer often spends a year or two in works before entering the technical high school; under the American plan the work in the schools of technology is made strongly practical and in addition, a special summer course of testing work is often performed; the English plan is therefore a compromise between the other two. An increasing number of English firms offer facilities to their employés by supplying works technical classes as at Horwich (Lancashire and Yorkshire Railway Co.) and Gainsborough (Marshall, Sons, and Co.) or by the offer of scholarships and free tuition at local evening classes, *e.g.*, Messrs. Dobson and Barlow, of Bolton; Vickers, Sons, and Maxim,

Sheffield; David Thompson and Co., Edinburgh; Mather and Platt, Salford.

In the case of the Chelsea Polytechnic certain students preparing for the Mercantile Marine put in a two or three years' course, and the usual four year's apprenticeship is thereby shortened by two-thirds of the time so spent in recognised engineering courses. That the English Government departments are waking up is evident from the report of the Committee on the qualifications of foremen in Ordnance Factories. A circular was recently issued to the various schools of engineering in Great Britain stating "that in the Royal Ordnance Factories at Woolwich, Enfield, Waltham Abbey and Birmingham, men possessing higher qualifications, preferably of the University type, shall be selected to fill appointments in the upper division, and that the educational qualifications for such appointments shall be based upon the examination results in the college courses so far as technical and scientific knowledge is concerned, and upon their record of training in the Ordnance Factories with regard to practical knowledge." At the Heriot-Watt College, Edinburgh, arrangements have been made with several local firms for students to start as apprentices at the end of the second winter session and to return to the workshops at the end of the third session, their apprenticeships being reduced by one year on taking the college diploma and a special wage being paid to them. The Scottish technical institutes are particularly fortunate in attracting the co-operation of local firms, *e.g.*, at the Glasgow and West of Scotland Technical College the members comprising the Departmental Committee for the boilermaking classes include the chairman of the governors and two other governors; two co-opted members; Lloyds chief engineer surveyor in Glasgow; the professor of prime movers, and two representatives from the Boilermakers and Iron Shipbuilders Society.

While such a close agreement between the employers of labour and the colleges is most promising, it must be remembered that in America such an agreement has been in force for several years with many firms of the front rank, and every inducement is offered to attend the day classes in technical

institutes—a point at which English employers still continue to look askance. The attitude of the German engineering firms may be judged from the action of first-class firms like Krupp of Essen, or the Deutsche Waffen u. Munitionsfabriken of Berlin, who employ only fully trained engineers on the completion of their technical high school course. In other German firms it is impossible to obtain any good position without having attended the "Maschinenbau Schule" (intermediate technical school) or the "Polytechnicum" (technical high school); amongst such firms may be mentioned the Berliner Maschinen-Bau A.G.; Gasmotoren Fabrik, Deutz; the Rheinische Metallwaaren u. Maschinenfabrik, Düsseldorf; Norddeutsche Lloyd, at Bremen; Hartmann and Braun, of Frankfort; and J. E. Reinecker, of Chemnitz.

For this international rivalry in trade and commerce the best preparation is undoubtedly an adequate supply of skilled artisans led by employers of labour who fully recognise the value of technical training based upon a good general education.

The Universities

THE UNIVERSITIES.

In approaching the study of the American colleges and Universities one is reminded of the state of English secondary education some ten years ago. There is the same overlapping and diffusion of energies, the same steep curve of efficiency between the best and worst types of institutions and the same chaotic condition produced by diversity of aims. Of the five hundred degree-giving institutions it is doubtful whether there are more than thirty offering a type of instruction as high as is found in an English University. Of the remainder the majority have no claim to the title either by equipment or teaching capacity; in fact, the larger city high schools may be considered more efficient from every point of view.

The freedom with which the Colleges have been allowed to flourish may be judged by considering that in the Education Report for 1901 no less than 35 institutions are credited to the State of Ohio; Pennsylvania has 36, and Illinois possesses 30. The total number of degrees conferred by the whole of the American Colleges reached the stupendous total of 16,500 (including 350 Ph.D.'s), of which number 11,500 were conferred upon men and 5,000 upon women. It will thus be imagined that there is no country where the variation of the intellectual standard of higher education is so great and where the value of a degree needs more careful examination. But, just as the influence of public opinion has raised the standard of American primary and secondary education so will this same influence be brought to bear upon the colleges and compel the inferior types to cease granting degrees and act as feeders to institutions more fitted to offer the highest grade of learning. That the front-rank colleges are aware of the importance of the question is evident from the recent stiffening of the examinations on the part of the various College Entrance Examination Boards. Harvard, Cornell, and Johns Hopkins are insisting that a student shall possess an Arts or Science degree before entering upon any professional course of study. In 1901, out of 655 students attending the Harvard School of Law no less

than 611 were graduates, and of 209 students in the Johns Hopkins Medical School not a single one had failed to possess a degree in Arts or Science. On the other hand, students are able in the majority of colleges to enter from secondary schools and obtain the medical degree after four years' study, and, even at Yale University it was possible to graduate in medicine after a three years' course so recently as 1896.

Returning to the question of the 35 better-class Colleges and Universities, these may be divided into two types: (1) the private type such as Yale, Harvard and Princeton modelled upon the older English Universities, with a governing body of trustees and possessing accommodation for students living in the building; (2) the newer or public type of institution established by the State and governed by a body called the Regents. As a rule tuition is free in the latter type, and the disciplinary regulations allow students to live where they please. The Universities of the States of New York, Michigan, Wisconsin, Minnesota, and California are good examples of this type, the last-named institution being a happy exception to the rivalry which has sometimes arisen between the State and private universities resulting in a diffusion of energy and a consequent decrease in efficiency. Chicago University differs from an English provincial university in that it organises and controls the secondary educational area, but, on the other hand, it receives no State or municipal support. All the well-known universities are co-educational except Harvard and Princeton, and even the former has a women's annex (Radcliffe College), where lectures are delivered by the University lecturers. In speaking of co-education at Cornell, President Schurman states: "Co-education is so firmly established and so thoroughly accepted at Cornell University, and is so much a fundamental idea of the institution that any reason in favour of the principle or indication drawn from experience could not be such a wasteful and ridiculous excess of words. There is no call even to discuss the workings of the system as the presence of women at Cornell on equal terms with men has not created any specific problems for the authorities of the University." As the number of women resident at Sage College,

Cornell University, is only 200, the problem of adjustment presents little difficulty there, but in the western colleges the question of co-education has recently forced its way to the front. Anxious as the Presidents are to note the increasing demand for higher education, the wishes of the founders and benefactors have to be considered. The women students of Chicago University are outnumbering the men, attracted no doubt by the reputation of the pædagogical department, and there co-education takes place during the last two years of college life, the women receiving separate instruction during the Freshman and Sophomore years. Again, the number of women admitted to the Leland Stanford Junior University in California has been limited to 500 at any one time, as the wishes of the founder were in favour of a great men's college.

In the purely State Universities there are no restrictions placed on women with regard to courses, and a number take up professional studies. Last year, in the University of Michigan there were 31 women studying medicine, six in the law department, a dozen in the department of homœopathic medicine, and the same number taking dentistry. Of course this was in addition to a large number in the classical and modern language departments. Notwithstanding this influx of women to the universities the colleges specially reserved for women continue to show increasing numbers. The largest—Smith College, Massachusetts—has over 1,100 students; Wellesley and Vassar have 700 each; Bryn Mawr, in Pennsylvania has about 400. Nothing is more surprising than to note the elaborate equipment for scientific and physical needs in these institutions. The Farnsworth School of Art at Wellesley; the Hilyer Art Gallery at Smith College; Dalton Hall of Science at Bryn Mawr; and the Vassar Astronomical Observatory all show the extensive care and attention paid to all branches of education. The fees in the women's colleges range from £20 to £35 a year, the cost of living being estimated at about £60. The requirements for admission are identical with those of the College Entrance Examination Board, *e.g.*, in the case of Vassar College the subjects are: (1) English; (2) History; (3) Algebra; (4) Geometry; (5) Latin; (6) Greek or

Latin or French (advanced); (7) German or French or Science. It is not surprising to find the standard of work for graduation equally high. At Wellesley in the 2nd year classical course the students read Herodotus, Thucydides, Demosthenes, and Aristotle, together with five plays from the great dramatists. The Latin course includes the works of Tacitus, Juvenal, Plautus and Cicero, with prose and verse composition. A student is required to take science each year, *e.g.*, chemistry in the sophomore year, physics for the junior year, and geology and astronomy in the senior year. Notwithstanding the heavy study it does not seem to have any detrimental effect on the general health of the American girl. To quote the words of Dr. Taylor, of Vassar College, "It would be difficult to find several hundred young women of the same general social conditions in more generally good health and spirits than those who have just closed the current academic year in women's colleges. There is nothing in the college training of women to contribute to abnormal results. A healthy mind and a healthy body and absolutely natural and healthy sentiments towards life are the general product. No work promises more for the future than the thorough education of a country's girls."

In no other country are the ideas of women's education so broad and unprejudiced, and the words of Matthew Vassar are generally accepted as a truism, "I think that woman, having received from her Creator the same intellectual constitution as man has the same right as man to intellectual culture and development."

Turning aside from the question of woman's education to the study of the American Universities mentioned previously, we notice that, notwithstanding the weakness of a great number of them, the first grade institutions have a standard of culture and refinement not inferior to that of any European University. Postgraduate work of a high order is pursued at Harvard, Johns Hopkins, and Clark Universities; the Engineering School at Cornell, the departments of pædagogy and theology at Chicago are also examples of fine organisation for intellectual work made possible by the support of enthusiastic benefactors. The following tables taken from the Report of the Commissioner of Education for 1901 show the size of the universities and professional schools connected therewith:—

Name	INCOME.					Benefactions for Years 1900-01.
	uition Fees.	Funds.	State or Municipal Grants.	Federal Grants.	Other Sources.	
	£	£	£	£	£	£
Universi	0	33,800	48,700	8,000	4,000	20,000
Leland S	5,000	40,000	—	—	—	—
Yale ...	7,400	56,200	—	—	150,000	190,000
Universi	5,000	5,600	48,000	8,000	48,000	500
Universi	9,000	42,700	—	—	53,000	515,000
Johns H	7,600	22,000	4,800	—	—	10,400
Harvard	8,000	114,000	—	—	42,000	190,000
Clark U	590	6,700	—	—	839	—
Universi	9,000	7,200	57,000	—	11,600	7,800
Universi	5,000	10,600	44,000	8,000	3,600	10,000
Princeto	5,000	25,000	—	—	—	—
Cornell U	9,000	80,000	—	7,700	2,800	190,000
Columbi	8,000	90,000	—	—	75,000	72,000
New Yo	9,000	17,600	—	—	—	35,000
Universi	9,000	28,000	—	—	—	95,000
Universi	9,600	4,800	85,000	8,000	560	1,000
Smith C	£ 5,000	£ 14,000	—	—	£ 6,000	£ 4,100
Wellesle	9,000	1,600	—	—	—	45,000
Vassar C	9,000	10,000	—	—	31,000	12,600
Bryn Ma	9,100	12,400	—	—	50	—
Barnard	1,080	1,930	—	—	350	—
Radcliffe	2,000	2,000	—	—	100	—

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STATISTICS RELATING TO THE LARGER AMERICAN COLLEGES AND UNIVERSITIES, 1900-01.

I. Colleges for Men and for both Sexes.

Name of College or University.	Date of Opening.	Number of Professors.	Number of Students.		Number in Mechanical Engineering.	Civil Engineering.	Electrical Engineering.	Chemical and Mining Engineering.	Living Expenses.	Tuition Fees.	Number of Scholarships.	Value of Apparatus, &c.	Value of Buildings.	INCOME.					Benefactions for Years 1900-01
			Men.	Women.										Tuition Fees.	Funds.	State or Municipal Grants.	Federal Grants.	Other Sources.	
									£	£		£	£	£	£	£	£	£	£
University of California†	1869	188	1931	1386	*a*159	74	—	357	60	0	67	76,000	364,000	0	33,800	48,700	8,000	4,000	20,000
Leland Stanford University	1891	136	910	479	27	46	38	—	60	0	—	50,000	400,000	5,000	40,000	—	—	—	—
Yale	1701	271	2415	127	73	52	37	—	100	31	—	—	—	97,400	56,200		—	150,000	190,000
University of Illinois†	1868	242	2040	465	109	128	91	4	42	0	265	63,000	200,000	25,000	5,600	48,000	8,000	48,000	500
University of Chicago	1892	256	1844	1676	—	—	—	—	60	24	200	78,000	800,000	60,000	42,700	—	—	33,000	515,000
Johns Hopkins	1876	118	613	38	—	—	—	—	46	30	190	51,000	200,000	7,600	22,000	4,800	—	—	10,400
Harvard	1638	483	4288	0	64	62	42	42	60	30	253	—	1,350,000	128,000	114,000	—	—	42,000	190,000
Clark University	1889	11	31	2	—	—			?	20	—	—	46,000	500	6,700	—	—	839	—
University of Michigan	1837	233	‡2881	831	*b*281	51	24	—	38	6	—	150,000	280,000	39,000	7,200	37,000		11,600	7,800
University of Minnesota†	1868	275	2417	996	70	79	79	96	60	3	28	42,000	280,000	18,000	10,600	44,000	8,000	3,600	10,000
Princeton	1746	92	1277	0	—	97	7	—	40	30	107	—	—	35,000	25,000	—	—	—	—
Cornell†	1868	327	‡2397	583	482	183	179	—	90	20-25	566	148,000	560,000	50,000	80,000	—	7,700	2,800	190,000
Columbia	1754	359	‡2657	429	101	81	110	116	80	30	87	152,000	1,650,000	88,000	90,000	—	—	75,000	72,000
New York University	1831	186	‡1436	343	39	48	—		80	20		15,800	446,000	29,000	17,600	—	—	—	35,000
University of Pennsylvania	1740	265	2278	295	72	53	45	12	100	30-40	140	320,000	800,000	65,000	28,000				95,000
University of Wisconsin†	1850	183	‡1945	674	*c*237	77	89		70	Free—Res. £6—Non-Res.	9	73,000	300,000	9,600	4,800	85,000	8,000	560	1,000

II. Colleges for Women.

									£	£		£	£	£	£	£	£	£	£
Smith College (Mass.)	1875	77	—	1133	—	—	—	—	60	20	100	22,000	130,000	25,000	14,000	—	—	6,000	4,100
Wellesley College (Mass.)	1875	75	—	716	—	—	—	—	45	35	71	43,000	220,000	49,000	1,600	—	—	—	45,000
Vassar College (N. Y.)	1865	68	—	702	—	—	—	—	60	20	7	21,000	240,000	51,000	10,000	—	—	31,000	12,600
Bryn Mawr (Pa.)	1885	42	—	398	—	—	—	—	60	30	54	9,600	143,000	9,100	12,400	—	—	50	—
Barnard College (Columbia Univ.)	1889	42	—	384	—	—	—		60	30	32	2,000	125,000	13,080	1,930		—	350	—
Radcliffe College (Harvard)	1879	104	—	457	—	—	—	—	90	40	15	6,000	68,000	16,000	2,000	—	—	100	—

a includes Electrical Engineering.
b includes 212 Engineering Students unclassified.
c includes 167 Freshmen not specialised.
‡ includes Students in summer Schools.
† College of Agriculture and Mechanic Arts

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STATISTICS RELATING TO THE CHIEF AMERICAN PROFESSIONAL SCHOOLS, 1900-01.

I.—Medicine.

Name.	Date of Opening.	No. of Professors and Assistants	No. of Students.		Graduates	Students having A.B. or B.S. Degree.	Duration of Course.	Endowment.	Income.
			Men.	Women.					
							Years	£	£
University of California	1862	33	139	22	28	48	4	—	4,000
Yale University	1813	26	133	0	18	25	4	21,000	—
Rush Medical College (Chicago)	1837	127	1055	—	206	164	4	—	22,000
Johns Hopkins University	1893	37	187	22	53	209	4	86,000	14,000
Harvard University	1782	70	603	—	116	56	4	—	—
University of Michigan	1850	30	563	—	75	—	4	—	—
Columbia University	1807	77	797	—	147	307	4	95,000	—
Cornell University	1898	88	211	21	26	35	4	—	9,000
University of Pennsylvania	1765	59	565	0	160	29	4	10,000	21,000
University of Wisconsin	1893	41	117	5	18	9	4	—	—

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UNIVERSITY OF CALIFORNIA

STATISTICS RELATING TO THE CHIEF AMERICAN PROFESSIONAL SCHOOLS, 1900-01.

I.—Medicine.

NAME.	Date of Opening.	No. of Professors and Assistants	No. of Students.		Graduates	Students having A.B. or B.S. Degree.	Duration of Course.	Endowment.	Income.
			Men.	Women.					
							Years	£	£
University of California	1862	33	139	22	28	48	4	—	4,000
Yale University	1813	26	133	0	18	25	4	21,000	—
Rush Medical College (Chicago)	1837	127	1055	—	206	164	4	—	22,000
Johns Hopkins University	1893	37	187	22	53	209	4	86,000	14,000
Harvard University	1782	70	603	—	116	56	4	—	—
University of Michigan	1850	30	563	—	75	—	4	—	—
Columbia University	1807	77	797	—	147	307	4	95,000	—
Cornell University	1898	88	211	21	26	35	4	—	9,000
University of Pennsylvania	1765	59	565	0	160	29	4	10,000	21,000
University of Wisconsin	1893	41	117	5	18	9	4	—	—

II.—Law.

Name.	Date of Opening.	No. of Professors and Assistants	No. of Students.		Graduates	Students having A.B. or B.S. Degree.	Duration of Course.	Endowment.	Income.
			Men.	Women.			Years	£	£
University of California	1878	5	120	5	39	58	3	28,000	1,900
Leland Stanford University	1892	11	196	1	32	19	3	—	—
Harvard University	1817	13	655	0	145	611	3	100,000	24,000
Yale University	1824	30	213	0	19	—	3	15,000	—
University of Michigan	1859	27	825	5	217	—	3	—	—
Cornell University	1887	10	179	3	44	14	3	—	—
University of Pennsylvania	1790	20	342	5	79	142	3	—	11,600
Columbia University	—	8	423	—	99	—	3	—	—
New York University	1834	17	582	45	103	112	2-3	—	11,000
University of Wisconsin	1868	8	264	2	70	17	3	—	2,800

III.—Theology.

Name.	Date of Opening.	No. of Professors and Assistants	No. of Students.		Graduates	Students having A.B. or B.S. Degree.	Duration of Course.	Endowment.	Income.
			Men.	Women.				£	£
Harvard University	1817	10	28	0	2	24	3	—	—
Yale University	1821	15	87	0	26	79	3	140,000	7,000
Chicago University	1866	25	352	21	18	—	—	—	—

IV.—Dentistry.

Name.	Date of Opening.	No. of Professors and Assistants	No. of Students.		Graduates	Students having A.B. or B.S. Degree.	Duration of Course.	Endowment.	Income.
			Men.	Women.				£	£
University of California	1881	21	150	0	51	—	3	—	—
Harvard University	1867	43	126	0	29	7	3	—	—
University of Michigan	1875	13	263	10	73	7	3	—	3,800
University of Pennsylvania	1878	42	417	0	154	22	3	—	92,000

Attention is drawn to the following points in the tables: —

1. Federal grants are made to those universities, which are also colleges of agriculture and mechanic arts, the grant going towards the maintenance of an agricultural experiment station.

2. In the State universities no fee is charged for tuition to residents.

3. The Western universities have a larger number of women students than in the Eastern States.

4. The total sum of the benefactions received by all institutions of higher education in the year 1901 amounted to £3,400,000.

5. Of the total income of the above colleges and universities the portion derived from tuition fees was 37 per cent.; endowment, 29 per cent.; State or municipal aid, 20 per cent.; Federal aid, 4 per cent.; other sources, 10 per cent.; total, 100 per cent.

Except Johns Hopkins and Columbia the number of medical students possessing an arts or science degree is extremely limited. In the case of the Schools of Law the exceptions are Harvard and Pennsylvania. The value of apparatus, etc., bears a very high proportion to the nature of the buildings, notwithstanding the comparatively recent date of foundation of several of the colleges. As a rule American colleges are of plainer exterior than English institutions, but no expense is spared upon their internal equipment. The Bicentennial buildings of Yale, and the Dining Hall at Chicago, are examples of the newer type of architecture and are extremely handsome in appearance.

The visit to several of the universities proved most interesting, and through the courtesy of the various presidents and professors the writer was enabled to make a close study of the methods of work and to collect ideas valuable from an educational point of view.

Starting with Columbia University, New York, one is reminded of its first charter granted in 1754 by King George II. to "King's College, in the City of New York," "for the education and instruction of youths in the liberal arts and

sciences." The first portion of its endowment was obtained by public lottery. In 1776 the college buildings were used by the troops, and for a period of eight years its function as a college lapsed. With the aid of Governor Clinton the college received a charter in 1784, and its name was changed to Columbia College. The fine buildings which the University now occupies on University Heights are of recent date (1895) and were largely the result of the untiring efforts of its President, Seth Low. Among the interesting features of the university are the School of Music (one of the first established in America); the university library, containing over 100,000 volumes; the law library, strong in international and constitutional law; the medical school endowed by W. H. Vanderbuilt and W. D. Sloane; and the Teachers' College. The last-named, which is an independent corporation and has entire financial responsibility, has courses including:—

(*a*) Graduate courses leading to master's or doctor's diplomas.

(*b*) Two years' professional courses for teachers and supervisors in kindergarten or elementary schools or for specialists in domestic art, fine arts, manual training, and music.

(*c*) Collegiate course of two years which, if followed by two years' professional course, leads to the degree of B.Sc.

In connection with the Teachers' College it may be mentioned that the Horace Mann School contains complete kindergarten, primary, grammar, and high school departments, while the smaller Speyer School contains kindergarten and primary schools only.

It is typical of the interest taken in education by the American people that the President of Columbia, Professor Nicholas Murray Butler, LL.D., is equally renowned as a leading educational expert as for his splendid qualities as organiser of a rapidly developing college.

In passing from Columbia to Harvard University the thoughts of an English visitor change from the colonial days to the Puritan period, since it was in the year 1636—six years after the landing—that the colony, with Sir Harry Vane as

Governor, put forth efforts resulting in the founding of a college at "The New Towne"—the name being changed to Cambridge to indicate "the high destiny to which they intended the institution should aspire."* The Rev. John Harvard, of Emanuel College, bequeathed one half of his estate and his library of 320 volumes towards the endowment of the college. The original single building and its three acres of ground was thought by some to be "too gorgeous for a wilderness and yet too mean in others' apprehension for a college." According to the annals of the period the quaint discipline of the "boxing" of the undergraduates was stringently applied, and students were prohibited from attendance at parades or the joining of any military band "unless of approved gravity or of approved sober and virtuous conversation." The present Harvard undergraduates conducts himself differently from his predecessor, who was ordered to avoid "the use of liquors, and the preparing and providing either plum cake or roasted, boiled, or baked meats or pies of any kind." Likewise the appeal "to put an end to the practice of addressing the female sex" would be wisely disregarded by our modern freshman, and the presence of enthusiastic sisters at intercollegiate games would be enough to make the former Fellows and Presidents turn in their graves.

Of the present Harvard buildings the most interesting are the old Law School, the library designed from King's College Library, Cambridge, and the Massachusetts Hall, which dates from the year 1720, and is the oldest building standing. Of the more modern buildings may be mentioned the Lawrence Scientific School which has recently had an engineering laboratory erected; the fine Jefferson Laboratory devoted to physics; the University Museum connected with the names of Louis and Alexander Agassiz; the Peabody Museum of American archæology and ethnology rich in Mexican pottery, Peruvian crania, and collections from ancient mounds and graves found in America. The medical buildings of the university are situated in Boston, and the reorganisation of the courses under

* "History of Higher Education in Massachusetts," by George Gary Bush, Ph.D. Chapter ii.

President Elliot has attracted a good number of students. In 1903 there were 36 professors and 114 instructors, lecturers and assistants on the medical staff. The choice of hospitals for practice is very wide—no less than 13 city hospitals being open to students. Of the professional schools the Law School has a deservedly high reputation.

A few words may be said about the system of teaching at Harvard. There are few courses of pure lectures or pure recitations. In the elementary classes lectures run parallel with the text-book work, and in some cases these sets of lectures are executed monthly, half-yearly or yearly. On the philosophical side, the time is occupied with a debate between professor and students. Laboratories and libraries are, of course, widely used, American students being taught to acquire information on special subjects with ease and accuracy. The half-yearly and yearly examinations are fairly stiff, and a man who "cuts" his lectures is quickly dropped, consequently the student who tends to be slack finds himself well looked after. The elective system has recently been introduced with great success, likewise the English tutor system whereby the freshman receives help in his choice of work. With regard to the elective system the courses of study for the following session are issued early in June, and the student makes his choice as soon as possible.

Mention has already been made of Radcliffe College—the Women's Annex at Harvard. Two certificates are awarded on a four years' course, viz., a certificate equal to the B.A. degree and a certificate simply stating the attendance of a four years' course. It is interesting to note that many of the students at Harvard work their way through by means of a self-help bureau, the work consisting of tutoring, translating, copying, teaching, and acting as travelling companions, type-writing or shorthand clerks. At Columbia University medical medical and engineering students are advised against taking such work as being likely to impede their studies, and at Cornell the same advice is given to all students. On the other hand, Chicago University offers every facility in this direction to the deserving student, and the writer saw students even acting as waiters and clerks in the college dining room. At Harvard

one sees the college customs at their best. There is Class Day with its procession to Appleton Chapel, where odes, poems and orations are delivered by the different members, the remainder of the day being devoted to social entertainment. On Commencement Day, the Medical Hall is filled with professors and undergraduates to hear the orations, dissertations and disquisitions from students who have graduated "summa cum laude," "magna cum laude," or "cum laude" respectively. At Harvard, too, the college fraternities receive strong support from the students; the best men of the year are elected without regard to social or class distinctions, and in this way the secret society is formed with links at other universities so that in after life the members may meet and keep in touch with one another. At Harvard, the importance of athletics in an American university is emphasised by the elaborate fittings of the Hemingway gymnasium and by the physical tests made on the athletes before taking part in any athletic contest—all displaying a precision and accuracy that is typical of the best American brains. At the same time the writer was reminded of the tendency to overdo college athletics by observing the inadequate equipment of the engineering laboratories owing to lack of endowment, and yet there was in process of erection on the athletic field a most elaborate stadium—copied from the Roman Coliseum—upon which a sum of £35,000 had been expended. The arena contained a football field and running track, and the huge seat structure made of cement blocks and steel rising to a height of 50 feet, formed a remarkable picture from the architectural point of view.

In order of precedence YALE naturally follows Harvard since it was in 1701 that a number fo Congregational clergy in Connecticut petitioned for the founding of a college similar to Harvard wherein—to quote the pious founders—"Youths may be instructed in the arts and sciences, and, through the blessing of Almighty God, may be fitted for employment both in Church and civil state." With one exception the first body of trustees was composed of Harvard men. It is interesting to note that among the first contributors to the college library were Richard Steele, Sir Isaac Newton, Dr. Bentley, and Sir Richard Black-

more (Poet Laureate) all of whom had been approached in the matter by the English Agent General. The university received its name from Elihi Yale, a native of Boston, who became Governor of Madras and a benefactor of the college to the extent of "three bales of valuable goods, a portrait of George I., the royal coat of arms, and a case of books."* Unlike the early pupils of Harvard College, the Yale students were a lively lot, if one may quote from one of their exploits consisting in preparing "six quarts of rhum and about two payls fool of sydar and about eight pounds of suger," and making it into a concoction called "Samson," after which there was a "prodigious Rought"—naturally.

Among the early benefactors of Yale was Bishop Berkeley, who visited America for the purpose of founding a college to train Church of England missionaries. He had collected a sum of money, including £20,000 from Sir Robert Walpole and £4,000 from Miss Vanhomrig (Swift's Vanessa). His interest was aroused in the newly-founded college, and he made out a deed of gift conferring his Rhode Island farm of 96 acres for the maintenance of three students between their first and second degrees.

In their present state the buildings at Yale are a very interesting study, as there exists one of the oldest dormitories in America. Beautiful rows of elms intersect the campus and the college buildings, in the opinion of the writer, present a pretty picture unsurpassed for architectural beauty. The famous Sheffield Scientific School is better equipped than the Lawrence School at Harvard, and has a good reputation as a school of engineering, but it is rather curious to learn that in the Sheffield School first year students have no laboratory work. The Kent Chemical Laboratory is well equipped and the inorganic work is of a high order, but very little advanced organic chemistry is taken. Both Yale and Harvard have engineering depatrments inferior to those in American technological schools, the quality of the scientific work at Yale being rather lower than at Harvard, excepting perhaps in electrical

* "History of Education in Connecticut," by Bernard C. Steiner, A.M., p. 81.

engineering. Of course, it must be remembered that Harvard has nearly double the number of students, and in the departments of law and medicine the numerical superiority is most marked. A splendid feature at Yale is the psychological department, in which at present there are about 18 juniors, 17 graduate students from other universities, five senior students, and two taking a postgraduate course. The laboratory is furnished with a very complete set of apparatus, including tests for reaction and time movements, measurement of the intensity of sound, threshold of sound, perceptual fusion, line and spot illusions, and discrimination tests with chronograph and pendulum.

The professional staff at Yale has always had a high reputation, and among the past and present members may be mentioned Professor Cyrus Northrop (President of the North-western University); Professor Dana, the geologist; W. D. Whitney, Professor of Comparative Philology; Professor W. R. Harper (now President of Chicago University); General Francis A. Walker (late President of the Massachusetts Institute of Technology); and Willard Gibbs, Professor of Mathematical Physics. Among the list of alumni are the names of Chauncey Depew and Andrew D. White. In literature Yale can hardly supply names equal to Harvard, on whose roll of fame are the names of Longfellow, Russell Lowell, and Wendell Holmes.

Let us next turn to Cornell University—a typical modern university founded as a College of Agriculture and Mechanic Arts under the Morrill Land Grant Act of 1862. By this Act the State of New York became entitled to scrip representing about one million acres of land. Under the conditions of the Act the State was prohibited from locating the land outside its own area, and as there was at that time no available land for purchase it was necessary to dispose of the scrip. The founder, Ezra Cornell—a shrewd American business man—made arrangements to buy the scrip, and by reselling at a high price raised the income to be derived from the new university to a total of £60,000 a year.* He also gave a site of 200 acres at

* "History of Higher Education in the State of New York," by Sidney Sherwood, Ph.D. Chapter v.

Ithaca, overlooking Lake Cayuga. The college was built and opened in 1868 with a student roll of 400 and a staff of 25 professors, including J. L. Morris, in mechanical engineering; James M. Hart, in mediæval language; while among the non-resident professors were Jean Louis Agassiz, Goldwin Smith, James Russell Lowell, and Andrew D. White. Cornell has now about 3,000 students and 330 professors, and its financial prosperity may be judged from the endowment of £1,900,000 and the annual income of £140,000. As at present constituted, Cornell has the following departments:—

A. The academic course in arts and science divided into:
  (1) Arts and classical course requiring Latin and Greek.
  (2) Philosophy or literature course requiring Latin and modern languages.
  (3) Science course requiring modern languages, mathematics, and natural science.
  (4) The Letters course requiring modern languages, literature, philosophy, and elementary mathematics.

B. Technical and professional courses divided into:
  (1) Agriculture.
  (2) Mechanical and electrical engineering known as the Sibley College of Mechanical Engineering.
  (3) Civil engineering.
  (4) Architecture.
  (5) Law.
  (6) Veterinary science (New York State Veterinary College).
  (7) Medical College.
  (8) New York State College of Forestry.

C. Graduate courses in arts, engineering, agriculture, and philosophy.

For admission to the college, candidates pass the examinations of the College Entrance Examination Board or give evidence of satisfactory work in a high school with a four years' course. Candidates who fail in one subject are admitted on

"condition," *i.e.*, they must obtain private tuition and pass a further examination in it.

The growing reputation of Cornell is attracting a larger number of students each year—the increase in four years being over 1,000. In 1902–3 there were 3,018 students divided as follows:—Graduate department, 201; arts and science, 795; law, 224; medicine, 393; agriculture, 114; veterinary science, 63; forestry, 70; architecture, 53; civil engineering, 253; mechanical and electrical engineering, 890; the number of engineering students thus gives Cornell a leading place among engineering schools.

At Cornell the "sabbatical year" is an institution which holds among the teaching staff by which any resident professor who has served for at least seven years may have leave of absence for one year with half his salary, thus giving time for visits to places of private research in Europe. Perhaps the most important growth of Cornell in recent years has been in the direction of a popular university, yet a university which should appeal strongly for State aid, like the State Universities of Michigan and California. The appeal for State aid was met by a grant of £10,000 for a dairy building in 1893, a sum of £10,000 for the veterinary college the succeeding year, and another £20,000 was added in 1895 under President Schurman's administration. A school of forestry has been recently established—unfortunately a difficulty arose last year (1903) in connection with the experimental tract in the Adirondacks, resulting in the State threatening to withdraw financial aid. One of the glories of Cornell is undoubtedly the engineering department, chiefly owing to the energy of the late Robert H. Thurston, Director of the Sibley College, and the late Professor Fuertes, Director of the College of Civil Engineering. As in most American schools of engineering, there is the usual concordat between the college and the various engineering concerns in the neighbourhood. The Lackawanna Railroad permits the use of locomotives and trains for road tests between Ithaca and Owego, while the Baltimore and Ohio R.R. offers facilities for running experimental trains over their track. The natural advantages arising from the situation of the college on

Lake Cayuga are taken advantage of in the hydraulic work and in the turbines driving the dynamos. Special hydraulic experiments have been carried out at the request of the U.S. Deep Waterway Commission, the Michigan Water Co., and the U.S. Geological Survey. Similarly the advanced students in that department of dynamic geology and physical geography—under Professors Tarr and McMurray—have carried on experimental work in the coal mines at Wilkesbarre, the Adirondacks, and the State of Louisana and the mountains of eastern New York have served as areas for study of geological problems. The equipment of the various departments, including the Veterinary College of New York State, all show the same high standard of excellence, and the universality of the instruction offered certainly bears out the wishes of the founder, Ezra Cornell. "I would found," said he, "an institution in which any person may find instruction in any study."

An interesting visit was paid by the writer to Clark University at Worcester, Massachusetts—the interest being due partly to the peculiar constitution of the university and partly to the remarkable achievements produced by an apparently incomplete idea of the founder. This university, the smallest in the United States in point of numbers, and yet notwithstanding its recent establishment exerting a great influence on the scientific education of the highest type, is now in its fifteenth academic year, having been founded by Mr. J. G. Clark, a native of Worcester, Mass., after a careful study of European educational institutions. The original plan of the founder was to have a purely Philosophical Faculty, devoted to a group of the pure sciences which underlie technology and medicine, but not to apply its work to these professional fields. The university started with only 5 departments, viz.: mathematics, physics, chemistry, biology, and physiology, the latter including neurology, anthropology, and education. Upon the death of the founder in 1901 the conditions of his will included the formation of a collegiate or undergraduate department leading up to the highest standard of the postgraduate work, and Mr. Carroll D. Wright, Commissioner of the Bureau

of Labour, Washington, D.C., was appointed President of the College. The collegiate department was probably rendered necessary owing to the shortage of members in the university courses.

For the first year, 1903, the numbers in the university were distributed as follows:—Professor and Assistant Professors, 10; Honorary Fellows, 7; Docents, 2; Fellows, 22; Scholars, 8; Students (not on appointment), 7; Specials, 5. Courses in psychology for teachers are held on Saturday mornings and the Summer School of Education is largely attended by the teachers and superintendents in the State. That the college is supported in its efforts to raise the standard of university teaching is evident from the magnificent endowments received from generous donors including Andrew Carnegie and the late Senator Hoar.

Plain and unpretentious in appearance like its neighbour, the Worcester Polytechnic, Clark University is equipped with a thoroughness and excellence that is somewhat astonishing. Concentrating its efforts on four departments (the chemical department was dropped some years ago and is not yet sufficiently supported to cause its re-establishment) the post-graduate work has been kept in mind. The new library erected at a cost of over £30,000, has been modelled on the library of Trinity College, Cambridge, and contains a fine collection of reference works and periodicals, American and European. In the mathematical department under Professor Story (Editor of the "Mathematical Review") there is a splendid collection of Brill's models and Björling's thread models of developable surfaces. The physics department, under Professor Webster, is equipped with specially devised apparatus more advanced in character than in any American laobratory. Here is the original interferometer used in the measurement of Jupiter's satellites by Professor Michelson, who was formerly professor of physics before leaving to take up the work at the Chicago University. Professor Webster's own researches on sound include the investigation of an accurate standard of sound, the propagations of sound over land and water, the efficiencies of sources of sound, and the investigation of Boltzmann's theories.

The physics apparatus, which is mostly made in the instrument shop, includes an oscillograph for the representation of wave forms, a chronograph driven by motor and regulated by tuning fork, a special galvanometer for alternating current on the resonance principle, a compound astronomical instrument and a Foucault heliostat. The instrument shop is equipped with machine lathes, planers and precision lathes of sufficient accuracy for the construction of a standard of self inductance wound on a marble cylinder for the American Bureau of Standards, of which institution Professor Webster was one of the originators. The largest number of students is in the psychological department, the head of which is the President of the University—Professor G. Stanley Hall. The other lecturers include Professor E. C. Sandford in Experimental Psychology; Professor Hodge in Physiology and Neurology; Professor Burnham in Pædagogy; and Professor Chamberlain in Anthropology. The department is furnished with seminary and library, workshop, research room, and a special room for keeping animals and for comparative psychology. The collection of apparatus is strong in instruments for the study of the senses and for psychological time-measurements mostly designed by the professors—in fact the study of experimental psychology has received a great impetus from the work done at Clark University. The departmental library is full in works upon experimental and physiological psychology, the section in criminology being especially well treated. Special lectures on psychiatry have been developed with a special view to the study of hysteria, mania, and illusions bearing on the important problems of the mental condition of the insane.

The investigations of the anthropological department have been directed among other subjects to the questions of the study of American aborigines—their folk-lore, arts and institutions. In the sub-department of education, besides the study of general educational principles, researches have been made on mental activity with relation to school work, sex development, etc. In the psychological department experimental work has recently been carried out upon the sensory powers of various animals, including rats, alligators and monkeys. In the latter

case the mental life of two monkeys *(macacus rhesus)* in captivity were studied to determine the extent to which the animals could discern form, colour, and the appreciation of numbers.

The aim of Clark University is to form a training ground for teachers of the highest rank, and the success is shown by the high position held by the graduates. Among the former members of the staff in the physics department are Professor Michelson, of Chicago, T. Procter Hall and F. L. O. Wadsworth. The chemical staff included Professor Nef, of Chicago University, and Professor A. A. Noyes, of the Massachusetts Institute of Technology; in biology Franklin P. Mall, Professor of Anatomy in Johns Hopkins University; in psychology, E. W. Scripture, Lecturer on Psychology, Yale University. With such a distinguished past it is to be hoped that the University Department will keep up the stringent standard with the new Collegiate Department. It is rather disquieting to note that the freshmen are admitted solely on certificate and the college course is to be limited to three years only. The low fee (£20) charged for the ordinary course is somewhat remarkable: in addition one finds that the value of the fellowships are low compared with English standards. There are eight Senior Fellowships of £120 each; eight Junior Fellowships of £50 each; eight Senior University Scholarships of £40; and eight Junior University Scholarships of £20.

It is sometimes objected that in America the colleges go in for quantity, not quality, of students, and this criticism is certainly valid in many institutions but it is the aim of Johns Hopkins University and Clark University to raise the standard and create a strong postgraduate department, and hitherto their efforts have met with the greatest success.

It is not surprising to find that the State of Pennsylvania is well equipped with institutions for higher education. From the statistics of the Bureau of Education we find the state is credited with not less than 36 degree-giving institutions, some of them small and of little importance, others taking rank with the best American colleges. In Pennsylvania is the Women's College of Bryn Mawr, also Swarthmore and Lafayette Colleges.

The Lehigh University at South Bethlehem has a strong department of engineering and is likewise noted for chemistry. The largest institution, of course, is the famous University of Pennsylvania in Philadelphia—next in point of age to Harvard and Yale and interesting on account of the connection of Benjamin Franklin during the early history of the University. In studying the history of the University of Pennsylvania we find that in the year 1749 a circular was drawn up and sent round to prominent citizens asking for help in organising the "Publick Academy in the City of Philadelphia."

A charter was granted by Thomas and Richard Penn, proprietors and governors, of the Province of Pennsylvania, to Thomas Lawrence, Benjamin Franklin, and to the other trustees of the above Academy, which in 1779 was incorporated in the University of Pennsylvania. From the beginning the University was unsectarian and, acting on the suggestion of the Archbishop of Canterbury when presenting a petition for a collection for aid in England, the original trustees placed on record their desire that in the election of officers the foundation should not be narrowed down in any way whatever. When we consider the influence of Franklin on public educational ideals—his plan "to serve mankind, one's country, friends and family"—and his utilitarianism we can understand his success with the ideas he formulated. To him are due the Library Company of Philadelphia, the precursor of American Public Libraries; the American Philosophical Society; the University of Pennsylvania, and the chief institutions in Pennsylvania formed after his own ideas, viz., Franklin and Marshall College, the Franklin Institute, Girard College, the Philadelphia Manual Training Schools, and the Drexel Institute.

Franklin's advocacy of the teaching of English as a living language; his belief in what would now be termed nature study; his strong claims in favour of scientific experiment; his preference for sound business training, proved his extreme clearsightedness in matters of educational policy.

Along with Hume and Adam Smith, Franklin was a good specimen of economic utilitarianism. By his will Franklin left £100 to the public schools of Boston to provide meals only

for deserving scholars. The Franklin fund for apprentices was also established by him in the following terms:—

"I have considered that, among artisans, good apprentices are most likely to make good citizens, and having myself been tied to a manual art, printing, in my native town, and afterwards assisted to set up my business in Philadelphia by kind loans of money from two friends there, I wish to be useful in forming and advancing other young men who may be serviceable to their country in both these towns. To this end I devote two thousand pounds sterling, of which I give one thousand thereof to the inhabitants of the town of Boston, in Massachusetts, and the other thousand to the inhabitants of the city of Philadelphia, in trust, to and for the use, interest, and purposes hereinafter mentioned and declared."*

The sum was to be let out at interest of five per cent. to young married artificers under 25 years of age who had faithfully served their apprenticeship—the amount not to be less than £15 nor more than £60 to one person. Each borrower was obliged to return one-tenth of the principal and accruing interest each year.

It is somewhat interesting to compare the educational views of John Adams, Thomas Jefferson, and Benjamin Franklin. John Adams, the first to incorporate the idea of public education which he did in the constitution of Massachusetts in 1870, identifies the interests of education with the interests of the masses, while Franklin worked out a system adapted to the wants of individuals but dependent on those individuals for its successful operation. Franklin did not identify the operation of his educational plans with the necessity and growth of the State; he laid strong emphasis on self-education as a natural method. Jefferson took higher ground, recognising that education must be directed by those technically trained to perform its duties. The public school system—the education of the masses by the masses—was John Adams' idea; the technical department in the University,

* Benjamin Franklin and the University of Pennsylvania," by Francis Newton Thorpe, Ph.D., p. 169.

Jefferson's idea; and we have the means of self-education, books, business, factories, libraries, learned societies, nature, and the human soul capable of making use of these opportunities, Franklin's idea.

The University of Pennsylvania now contains the oldest medical school in America, while the well-equipped dental school contains the largest number of students. The bacteriological laboratory of the University is remarkably well equipped and when the writer visited Philadelphia there was in process of erection a set of new buildings and various other improvements, including a medical laboratory to cost £120,000; a students' dormitory at a cost of £110,000; a new engineering laboratory at £140,000; gymnasium, £50,000; and a new athletic ground, £50,000. The present engineering department seemed most inadequate for the purpose of practical instruction, the workshop consisting merely of a corridor containing a few lathes and capable of accommodating no more than a dozen students.

The vigorous efforts which are now being made to bring the various departments in line with modern needs should make the University occupy a fitting place in the educational system of the State of Pennsylvania.

From Philadelphia to Baltimore is some two hours' railway journey, and one is reminded in travelling by the Baltimore and Ohio R.R. that one of its directors was the founder of what is perhaps the most advanced place of learning in the States. At the death of Mr. Johns Hopkins in 1873 he bequeathed one and a half million pounds for the endowment of the University and hospital bearing his name.

The aims of the University were to be "An enduring foundation; a slow development; first local, then regional, then national influence; the most liberal promotion of all useful knowledge; the special provision of such departments as are elsewhere neglected in the country; a generous affiliation with all other institutions, avoiding interference and engaging in no rivalry; the encouragement of research; the promotion of young men and the advancement of individual scholars, who by their excellence will advance the sciences they pursue and the society

where they dwell."* To carry out these aims the requirements were "a large staff of teachers; abundance of instruments, diagrams, books, and other means of research and instruction; good laboratories with all the requisite facilities; accessory influences coming both from Baltimore and Washington; funds so unrestricted, charter so free, schemes so elastic, that as the world goes forward our plans will be adjusted to its new requirements."

The Johns Hopkins University was opened in October, 1876, an address in anticipation of the proposed school of medicine being given by Professor Huxley.

The University always seems to have attracted the highest type of teacher to its ranks, and in no other college is the international reputation of its staff so great. Besides the President Emeritus Daniel C. Gilman, the staff includes the present holder of the office, Ira D. Remsen, Professors J. S. Ames and R. W. Wood in physics; Basil L. Gildersleeve in Greek; and Paul Haupt in Semitic languages. In the medical department are Professors W. Osler,† H. M. Hurd, H. A. Kelly, J. J. Abel, and F. P. Mall. It must also be remembered that Simon Newcomb was Emeritus Professor of Mathematics and Astronomy; H. A. Rowland made the University famous with his famous researches, while G. Stanley Hall (now of Clark University) was formerly Professor of Psychology. Much encouragement is given to research and several journals devoted to mathematics, chemistry, philology, biology, history, and Assyriology are published. A monthly meteorological report and a weekly crop bulletin are issued under the joint auspices of the State, the U.S. Weather Bureau, the University and the Maryland Agricultural College. Special publications are prepared, such as the report of the magnetic survey in Maryland by Dr. L. A. Bauer; also geological survey reports by Professor W. B. Clark, State Geologist for Maryland. Other publications in

* "History of Education in Maryland," by Bernard C. Steiner, Ph.D., p. 148.

† Dr. Osler has recently been appointed Regius Professor of Medicine in the University of Oxford in succession to Sir John Burdon Sanderson. As Physician-in-Chief of the Johns Hopkins University Hospital Professor Osler has attracted students from all parts of the United States and Canada, mainly by his unique personal relations with his classes.

the past include Rowland's reports on the mechanical equivalent of heat and also his solar spectrum maps; notes on Assyriology by Professor Haupt; and New Testament criticism by Professor Rendel Harris. The Johns Hopkins Hospital Reports and Bulletins are also issued from time to time.

The formation of the full medical school in 1893 was notable for the great financial help given by a committee of women for the furtherance of women's education, some £20,000 being collected by a ladies' organisation and aided by the generosity of Miss Mary E. Garrett, who contributed about £60,000, a total of £100,000 was raised. In 1902 the University itself received the gift of a new site and also a million-dollar endowment fund

Johns Hopkins is essentially a post-graduate place and of the 695 students attending for the Session 1902–3 no less than 533 (77 per cent.) were graduates; secondly, the University has a deservedly high reputation as a medical school, and 257 students are taking this branch of the curriculum. Of the 147 Professors about one-half are in the medical department.

The University offers instruction in:

(1) *Philosophy* to

- (*a*) College graduates intending to take the degree of Ph.D.
- (*b*) Undergraduate students taking A.B. degree.
- (*c*) Students not taking any degree.

(2) In *Medicine* to

- (*a*) Candidates taking 4 years' course for the degree of M.D.
- (*b*) Doctors of Medicine desiring to pursue certain special courses.

In the case of undergraduate students the matriculation requirements are very stiff, including Mathematics, Latin, Greek, or German and French, English History, Science, or Chemistry, Botany or Physical Geography. This examination may be passed in two parts.

The "group" system of study is rather novel, the groups being 7 in number and comprising (1) studies common to all the

groups and required of all undergraduates; (2) studies peculiar to a group; (3) optional studies.

Each group contains two principal studies, both of which extend over two years of instruction. Each group also contains 12 courses, eight of them being 4-hour courses, each representing 4 hours of class work weekly for a year. Of the others two are 3-hour courses; one is an elective of 2 hours in the 3rd year; and one (philosophy) occupies 5 hours weekly throughout one year. The groups are as follows: —

(1) Classical — Latin. Greek, Rhetoric, English Literature, German, one Science, Economics and History, Comparative Philology, Philosophy, and another elective subject.

(2) Mathematical — Physical Group. Mathematics, Physics, Chemistry; the remainder same as (1).

(3) Chemical — Biological or Preliminary Medical Group. Physics, Chemistry, Biology, also French, German, English, History, Philosophy.

(4) Geological — Biological. Biology, Geology, Physics and Chemistry.

(5) Latin—Mathematical. This is the same as (1) with mathematics instead of Greek.

(6) Historical—Political Group. This omits Greek and has only one year of Latin; it also includes History and Economic Science.

(7) Modern Language Group. This has one year of Latin, no Greek, English, French, German, Spanish, Italian.

It will be noticed that there are no schools of theology, law, dentistry, veterinary surgeon, or engineering—the strength of Johns Hopkins University lying in the departments of medicine, philosophy and pure science. The standing of the student of medicine is supposed to be superior to most of the American schools and a few details may be interesting. The requirements for admission are: —

(1) The A.B. (Arts) degree in the Chemical—Biological course.

(2) Graduates of approved colleges or scientific schools who can furnish evidence (*a*) that they have a general knowledge

of Latin, French and German; (*b*) that they have a knowledge of physics, chemistry and biology, as is imparted by the regular minor courses given in these subjects in the University.

(3) Those who give evidence by examination that they possess the general education mentioned in (2).

To illustrate the high standard required of the Johns Hopkins University School of Medicine, the following figures for 1902 indicate the number of graduates in each of the larger colleges.

Name of College or University.	Students in Medicine.	No. of Students possessing A.B. or B.S. Degree.	Per Cent.
Johns Hopkins	229	229	100
Rush Medical College	792	166	21·0
Harvard	506	228	45·1
Michigan	510	89	17·5
Columbia	827	60	7·2
Cornell	328	14	4·3
Yale	147	28	19·0
University of Pennsylvania	542	170	31·4
University of New York	306	46	15·0
University of California	125	42	29·9
University of Minnesota	341	8	2·3
Western Reserve University	126	30	23·8

While not assuming that some of these graduates are any better equipped than many men who enter straight from a high school, it is evident that in those medical schools which insist on a scientific training as at Johns Hopkins, the 7 years' course (three in science and four in medicine) ought to produce a fully qualified type of practitioner. On the other hand, there are several American medical colleges that do not even insist on the equivalent of a high school training and whose students would therefore compare most unfavourably with those in English and Scotch medical schools having a five or six years' course.

The equipment of the Johns Hopkins Medical School is most complete, as one would expect from its recent foundation. It

is situated some distance from the centre of Baltimore and has pleasant surroundings. There are two fine medical libraries, one in the Johns Hopkins Hospital for the clinical branches of work and another containing volumes on materia medica, physiology and anatomy. In the physiological department is a large laboratory for 50 students, while two other laboratories are used for physiological chemistry, pharmacology and toxicology, several students working by the aid of the Carnegie Research Fund. Professor Able was engaged on research work on epinephrin—used for hæmostatic purposes. In anatomy nine students were also at original work, under the guidance of Professor Franklin Mall, formerly of Chicago and Clark Universities. Dr. Mall has a unique and interesting collection of photos and sections in embryology.

At Johns Hopkins the scientific part of the medical school has a greater reputation than the clinical part. Comparing Johns Hopkins with other American schools of medicine, the former uses the inductive method of teaching from the practical side. At most universities the method is deductive, *e.g.*, by "quizzes"; in Johns Hopkins the student starts off by studying the cadaver, and under the guidance of the professor he sees a patient without knowing anything about medicine; his interest is thus aroused and he starts reading and gets in a position for acquiring knowledge.

It is noticeable that some of the State Universities are developing the faculty of medicine very strongly in the first and second years of training—the students afterwards entering first class schools upon advanced standing. In time these Universities will become strong enough to have a complete medical course like Cornell and Michigan.

At Johns Hopkins University there is a Summer Vacation School in medicine, but it is only sparsely attended, owing to the poor education of the medical men and to the fact that only the younger members of the teaching faculty take part in it. A notable feature of the medical course is the great number of students in the fourth or final year, the numbers for the four years being 51, 43, 67 and 96 respectively, showing the influence of admissions to advanced standing. In common with

Cornell, Johns Hopkins admits women to its medical school, and over 20 graduates of the women's colleges (Wellesley, Smith, and Bryn Mawr) are at present in residence. Four women students contributed papers which were published in the "Johns Hopkins Medical Journal" or the "American Journal of Medicine," whilst on the staff are two women as assistants in anatomy and gynæcology respectively. The President and Trustees of the University on receiving the Women's Medical School Fund expressed their opinion that "in hospital practice among women, in penal institutions in which women are prisoners, in charitable institutions in which women are cared for, and in private life where women are to be attended, there is a need and place for learned and capable physicians, and it is the business and duty of this Board of Trustees to make provision for the training and qualification of such women for the abundant work which awaits them in these wide spheres of usefulness." Under the terms of the Mary E. Garett Fund it is further enjoined that "women shall enjoy all the advantages of the Medical School of the Johns Hopkins University on the same terms as men, and shall be admitted on the same terms as men to all prizes, dignities or honours that are awarded by competition, examination, or regarded as rewards of merit."

Before leaving the University the writer visited the Johns Hopkins Hospital, directly opposite the Medical School, and which is built on an entirely up-to-date plan. The cost of erection was £400,000, and the annual cost of maintenance is about £40,000. Some twenty buildings have been erected, furnishing facilities for 330 in-patients. These buildings provide class-rooms in connection with out-patient work, a large clinical laboratory, operating rooms and clinic rooms, several lecture rooms, a clinical amphitheatre and an autopsy amphitheatre, also libraries and reading rooms. The ventilation and heating arrangements are particularly well adapted; the pipe tunnel in the basement encloses hot water pipes, electric wires, steam, gas, waste, and soil pipes, thus preventing any unsightly appearance of the basement. Great care is taken to prevent dust from the boiler gaining access to the

ventilating ducts. In addition to an ammonia compressor for the production of ice there are four boilers used for producing hot water at 120°F., five other boilers being used for steam. By a special arrangement the grease from the kitchen is collected in a trap, congealed and used for stoking. Each portion of a ward is filled with an outside "deck" for patients taking the air. With regard to the nurses, there are two sets of 35 probationers whose training consists of:—

(1) The care of the sick.
(2) The cooking of invalids' food.
(3) The preparation of food.

No drudgery is performed by these probationers, consequently a good class of women is obtained. In addition to the general cookery room there are special cooking and warming apparatus in each ward. Of the 350 in-patients accommodation is provided for 150 coloured people (some 20 per cent. of the population of Baltimore being coloured), and the nurses speak highly of the general tractability of these patients. The writer noticed arrangements for the treatment of lupus by the X-ray and Finsen ray methods—a modification of the Finsen lamp having been introduced by Prof. R. W. Wood, of the Physics Department.

In visiting the scientific laboratories at Johns Hopkins, the arrangements for research were particularly noticeable. In the Physics Laboratory the equipment includes a set of Rowlands' gratings, and one may see the three famous machines ruling 20,000, 15,000 and 14,438 lines to the inch respectively. Prof. R. W. Wood is noted for his researches on light, and an hour spent in viewing experiments opens out new ideas of the constitution of colour. The Chemical Laboratories, under Prof. H. N. Morse, are remarkably well equipped, and one may see physical chemistry of a high order under investigation. Prof. H. C. Jones, who is noted for his accurate work on solutions, was engaged on the conductivity of liquids in mixed solvents, the rise in the boiling point of concentrated solutions and the velocities of migration of ions in alcohol. Prof. Morse was at work on osmotic pressures of sugar solutions, using an

electrolytically deposited membrane of potassium ferro cyanide—the only point being that a pressure of over 32 atmospheres is obtained inside the cell, and Prof. Morse has perforce to turn potter and study the building of cells for the work.

The writer's next visit was to Prof. W. B. Clark, Director of the Maryland Weather Bureau, State geologist of Maryland and Professor of Geology in the Johns Hopkins University. The University gives a grant to the Director of the Weather Bureau as Instructor of Meteorology, and the State of Maryland also grants £400 as an appropriation for publication and experimental work. The Weather Bureau is under the Director of the Geological Department, as at Harvard, Columbus (Ohio), and Yale (New Haven), and the students have opportunities of assisting with the records, thus gaining practical training, and receiving financial help in return. Recent publications of the Department include works on the physiography and climatology of the State of Maryland and upon the climate of Baltimore City. As the headquarters for Maryland and Delaware the John Hopkins Meteorological Station receives reports from some 130 other stations, and with these the director makes out monthly reports of weather and crops—a valuable adjunct to the farmers. From the 9 p.m. night reports a two-day forecast of weather is made out, and from the 9 a.m. morning report a 36-hours' forecast is sent. The Director explained the method of sending off reports from the 3,000 stations in the States to the headquarters at Washington. The observer at each station reads the instruments in a definite order (time of reading not to exceed 15 minutes), puts his report into cipher and transmits it by telegrams—such messages having a right of way at a certain time of the day. It may be mentioned that the messages are tacked on to one another, gradually increasing in length on approaching Washington along the different routes. The celerity of the process is very striking and all the reports from the 3,000 stations are received within the period of one hour, the extreme points being over 4,000 miles away. European weather reports are also received from London. The Chief of the Weather Bureau sends a return account of other reports to each station sufficient

to enable that station to make up its weather map. Owing to its proximity to Washington, Baltimore has thus excellent opportunities for the study of meteorological phenomena, and its weather forecast is sent to 1,000 people by telephone or mail before mid-day.

In the case of the West Indian hurricanes it is not uncommon for the report to be two or three days ahead of the phenomena. The University has a small experimental station at Nassau in the Bahamas, where experimental kites register the pressure, temperature, and hygrometric state. The University Weather Bureau has a good collection of instruments, including one for the angular elevation of clouds, and a recorder giving simultaneous readings of wind direction, wind velocity, rainfall, sunshine, and barometric height. In the Geological Department some twenty students were taking advanced courses and assisting in survey work. The last U.S. Survey took place in 1833—42, and was revised in 1858—62, but was discontinued during the Civil War; most of the States have instituted independent surveys, but politics have prevented them from flourishing. In Maryland the State Geologist, Dr. Clark, is working in co-operation with the U.S. Survey Director, C. D. Woolcott. Of the £5,000 granted by the State of Maryland about £1,000 is laid aside for co-operative topography with the U.S. Survey; another £2,000 goes in the publication of reports on highways and £2,000 is spent on geological field work and in the publication of geological reports. There are in the Johns Hopkins Geological Department some 20 undergraduate students and 20 graduate students, the latter including 10 who are training for geologists. The students assist in the publication and in research work—the advanced field work in summer being paid out of the State Survey Fund; this work, of course, is arranged to fit in with the Director's own work as State geologist. The geographical library contains some 10,000 volumes, including a unique set of literature on climatology volumes of Indian geological memoirs, and special collections of works on economic geology. There are also special map bureaus and volumes on cartography. At the time of the visit a fine geological exhibition was under preparation for the St. Louis Exhibition. In connection with

the department, Dr. L. H. Bauer, Director of Magnetic work of the U.S. Coast and Geodetic Survey, has made a magnetic survey of Maryland with an accuracy which is unsurpassed by any country except Holland, since there will be on the average about one station to 100 square miles, compared with 1 to 40 square miles in Holland and 1 to 139 square miles in England. The account of the manifold activities of Johns Hopkins University is itself a refutation of the statement that American colleges possess a universal laxity of standard and it has remained for Clark and Johns Hopkins to show that it is better to concentrate resources and efforts on a few faculties rather than to have a large number of departments, some of which can never be adequately equipped.

When we travel from the quietness of the older universities such as Yale, Harvard and Pennsylvania to the more recent of the Central Western institutions we are struck by the immense difference in the character of organisation. From whatever point of view we consider the CHICAGO UNIVERSITY we can only describe it as colossal and as a triumph of man aided by unlimited resources.

If one considers that the first of these huge buildings—many of them showing considerable architectural beauty—was only erected in the year 1892 and that some additions are continually going on in order to afford accommodation for the rapid stream of students flowing from all parts of the State one is compelled to express admiration for the broadminded plan and statesmanlike ideas of its founders.

The idea originated from Mr. John D. Rockefeller, of Chicago, who suggested the formation of a new institution of learning in that city, and entered into communication with several ministers belonging to the American Baptist Education Society. A subscription list was opened and the sum of £200,000 raised, Mr. Rockefeller contributing £120,000; Mr. Marshall Field, of Chicago, granted a plot of land as a site for the University, and the area has been increased until the University grounds occupy 16 blocks lying between Washington Park and Jackson Park and fronting the Midway

Plaisance. Prof. W. R. Harper, of Yale University, was appointed President, and preparations were made for the buildings. The Theological Seminary at Morgan Park was removed to the University site as the Divinity School of the University, and an academy established in its place. Towards the cost of this Mr. Rockefeller contributed £200,000. The trustees of Mr. Ogden, of Chicago, granted to the University the principal portion of the money left by his will for charitable purposes. The shower of dollars upon the newly-fledged University then commenced in earnest. In February, 1892, Mr. Rockefeller gave another £200,000 and Mr. S. A. Kent, of Chicago, gave £50,000 for the building of a Chemical laboratory. Mr. Marshall Field gave £20,000 towards a building and equipment fund which was further increased to over £200,000. In December, 1892, Mr. Rockefeller gave a fourth subscription of £200,000 and Mr. Martin Rogerson, of Chicago, endowed the Physics Laboratory at a cost of £45,000. Mrs. Caroline E. Haskell, of Chicago, endowed the Oriental Museum at a cost of £20,000 as a memorial to her husband, Mr. Frederick Haskell, and Mr. Chas. T. Yerkes contributed £12,000 towards the erection of an observatory at Lake Geneva, Wisconsin.

In October, 1895, Mr. Rockefeller made a fresh donation of £400,000 on condition that an equal sum was obtained by subscription before January, 1896. Towards this sum Miss Helen Culver, a Chicago lady, at once presented £200,000 as a gift to be devoted to the increase of knowledge of the Biological sciences, and Miss Annie Hitchcock gave £40,000 for the building of a dormitory, and the remainder of the required sum was quickly obtained.

In 1901 it was decided that the Chicago Institute, founded by Mrs. Emmons Blaine should become a school of the University to be known as the University of Chicago School of Education; also that Southside Academy and the Chicago Manual Training School should be connected with the University under the name of the University High School.

In December, 1901, Mr. Rockefeller gave a further gift of £250,000, and in December, 1902, the sum of £200,000. The Freshman and Sophomore classes of Rush Medical College,

Chicago, were transferred to the University as the first two years of the Medical Course.

The growth of the University has been rapid for whilst the number of students in the first year (1892) was 900, in 1901–2 the number was 4,550. A remarkable feature of the University is the attraction it offers to women students, no less than 2,348, or more than one-half the total number, being of the female sex. Four residential halls for women have been erected, and further accommodation will no doubt be necessary. The School of Education, of course, is mainly filled with women and in 1903 there were only 21 men out of a total of 526 in that department. That the training of the women is high is apparent from the courses they are able to take up; no less than 356 are in the graduate department of Art, Literature and Science, most of them preparing to take the higher degrees of the University and a considerable number are taking the ordinary four-year college course. In the professional schools 31 women students are taking Divinity courses, two are in the Law School, and 29 attend the Medical course.

The increasing number of women is disquieting even to such a radical enthusiast like President Harper, and at present a compromise in the matter of co-education is in vogue whereby the women are separated for the first two years, but study with the men in the latter part of the course. Another point requiring consideration is the attitude of the benefactors towards the influx of women; in certain cases they may not be pleased to see the overpowering competition bringing with it great economic changes. The encouragement offered to the men is certainly very great; clubs, dining hall and dormitories have been erected and offered at a low expense. It is also rumoured that, other things being equal, a scholarship is given to a man. Naturally women figure on the professional staff, some 50 of the 330 lecturers and professors being women—most of them on the staff of the School of Education.

After a visit to the University a few personal impressions may be noted here. In the first place, the speed at which the work is carried on seems to be a distinct feature of a typical western institution. Unlike many universities Chicago is open

all the year round—the Spring, Autumn and Winter Quarters commencing on the first day of October, January, and April respectively, and the Summer Quarter on the day following the last day of the Spring Quarter. Each quarter is thus of about 12 weeks' duration, and the Summer Quarter is divided into two equal portions called terms. Certain of the elementary courses are repeated in each Quarter, partly owing to the large number of students in attendance and partly to allow students to commence their course at the opening of each period. Degrees are conferred at the close of each quarter, likewise the huge calendar appears four times a year.

The scheme of administration of the University is a model of clearness and insight into the needs of intending students; the educational net is spread wide to catch all kinds, and if the critic might suggest an increase in the size of mesh used the authorities will doubtless see to this point as the reputation of the University increases.

Commencing with the schools we have (*a*) the graduate school of a non-professional character and (*b*) the professional Schools of Law, Medicine, Theology, and Education. At present there are no Departments of Technology, Fine Arts, Music, and Engineering, but it remains to be seen whether the present existing technical institutes of Chicago will be affiliated to the University as in the newly-constituted London University, or whether, on the other hand, technological schools will be established at the University itself after the example of Harvard, Yale, and Pennsylvania. The Colleges of the University consist of (*a*) those in organic connection with the University, *e.g.*, Literature, Science, and Commerce, and (*b*) those institutions affiliated to the University and taking similar courses of study, *e.g.*, Kalamazoo College (Michigan), Des Moines College (Iowa).

It may be mentioned that the four-years' college course is divided into two equal portions called the Junior and Senior Colleges respectively, the idea being to enable students to elect courses in law, medicine and theology which will count towards the arts and science degrees and at the same time will satisfy the conditions for professional degrees. By

this method a student may possibly receive his Bachelor and also his professional degree in seven or even six years. In the case of the faculty of medicine, the requirements for admission are (a) a four years' high school course and (*b*) a course of university work extending over one year and a third. In future the University intends to demand still higher qualifications, viz., at least two years' academic work, before a student is allowed to enter on the four years' medical course.

The activity of Chicago is considerably widened by means of University extension lectures, summer courses and by correspondence courses, all of which are allowed to count as satisfying part of the requirements for a degree. In all cases a minimum time of one year of residence must be put in.

In the English Theological School the student may graduate by taking a four-year course each year, comprising a residential summer course and a non-residential correspondence course during the other threequarters of the year. In the case of the University extension lectures credit is given to students who send in work of a sufficiently high quality and who take the examination at the end of the course, but this non-resident work is accepted for only one-third of the work required for a degree.

In view of the probable system of affiliation which will come in the future between English city universities and the surrounding educational institutions it may be useful to give a short account of the Chicago system. With respect to affiliated colleges the University agrees: —

(1) To offer its examinations at cost in all subjects taught in the College.

(2) To confer upon the students at the College the same degrees and certificates to which each student would be entitled if in the University.

(3) To grant diplomas and degrees conjointly with the College to such students as pursue a course partly in the College and partly in the University.

(4) To grant free studentship for one year in the graduate school of the University to students who shall have earned the Bachelor's Degree contemplated in (2) and (3).

(5) To grant free tuition in medicine in its graduate schools to all instructors in the College under regular salary.

(6) To furnish to the College for temporary service, at cost, teachers, special instructors, and lecturers belonging to the University faculty.

(7) To furnish the College scientific apparatus, library books, etc. at cost.

(8) To furnish the College library with copies of all University publications.

(9) To unite with the College in nominating all instructors to fill vacancies in the faculty of the College.

(10) To elect the President of the College to membership on the University Council.

On the other hand the College agrees:—

(1) To employ only examinations approved by the University in final tests upon all subjects taught in the College.

(2) To adopt as far as practicable, courses of study and general regulations of the Colleges of the University.

(3) To elect only such instructors during the period of the affiliation as shall have been nominated by the College and University conjointly.

The regulations for the affiliation of High Schools and Academies have been given elsewhere (see remarks on Secondary Education). Under the above regulations some 16 academies and colleges have been affiliated—mostly in Illinois and the adjacent States; similarly there are 88 affiliated high schools (including 14 Chicago high schools), whose graduates are able to present certificates in lieu of certain university entrance requirements.

When the technological faculties have been added to the University it will present itself as a model of a well-organised civic University, with a dominating influence unparalleled either in America or Europe. With regard to the equipment, one naturally expects to find elaborate sets of materials, and everything that money can buy is present. In the scientific

laboratories there are five departmental libraries, and every facility is offered for research; each professor has one or more paid research assistants, and the time devoted to actual teaching is cut down as much as possible. Each member of the staff has three months' vacation at any time during the year, and if he wishes he may have leave of absence for a whole year on the "furlough" system. In the laboratory work students are "quizzed" on a group of experiments, and are then put to work them out, and a "seminar" held afterwards.

Of the other equipment the Yerkes Observatory at Geneva (Wisconsin) is a remarkable gift. The building is 330ft. in length, and has the dome for the 40in. telescope at the western end. This dome is 90ft. in diameter, allowing ample space for the great telescope, which is nearly 70ft. long. The heliostat room, 100ft. × 12ft., is situated between two smaller domes, containing a 12in. and 24in. telescope. The fittings on the 40in. instrument include:—

(1) A position micrometer.

(2) A wedge photometer.

(3) A double slide plate holder.

(4) A solar spectrograph.

(5) a spectroheliograph for photographing solar phenomena by monochromatic light.

(6) A stellar spectrograph for researches on the spectra and motions of stars, nebulæ, comets and planets.

In the Walker Museum there are strong collections on geological palæontology and anthropology, including collections from the Cliff Dwellings and Cave Houses of Utah; ethnological specimens relating to the Eskimos and Aleuts and of palæontologic collections of Palæozoic rocks from the Mississippi basin. In the Haskell Oriental Museum are collections of Egyptian pottery, and a remarkable collection of implements illustrative of Hinduism, Buddhism and Shinto.

When the writer visited the University in November, 1903, the School of Education was just nearing completion, and along with the Teachers' College of Columbia University, New York, offers an example of the rapid growth of the study of

Pædagogics. The School occupies a portion of the same block of land as the University High School, and contains an elementary department and the Dewey Laboratory School, so that every facility is at hand for the practice of teaching methods. In the basement of the Dewey School are the casting and kiln rooms, on the third and fourth floors is the Department of Domestic Arts, also rooms for psychology, textile work and clay modelling. The kindergarten and first four grades are on the first floor, the last four grades on the second floor. There are physical, biological and chemical laboratories, which are used by both the Elementary School and the Pædogogical Department. Another room is utilised as a library and museum, and there is a special room for blackboard drawing. Other portions of the fourth floor are devoted to drawing and painting; between the Education building and the High School is the special gymnasium.

The educational classes offered are:—

(1) Courses for Arts and Technology.

(2) General course for kindergarten teachers, critic teachers, elementary school teachers and supervisors.

(3) Courses for teachers in secondary and normal schools.

The entrance requirements are:

For Course 1—Four years high school course and at least two years experience in teaching.

For Course 2—Graduation certificate from an approved high school, together with two years' work of a college grade. The latter may be done either in a college or in a normal school for teachers.

For Course 3 the student must have completed two years of junior college work.

Facilities are afforded students of pursuing studies leading to degrees in Arts, Science, Philosophy, and Education.

To conclude this description of Chicago University it may be interesting to show how the students are distributed in the various departments. The presence of the women in every faculty is shown in a very marked manner.

A. School of Art, Literature and Science.

	Men.	Women.	Total.
1. Ph.D.	22	0	22
2. Higher Degree	96	35	131
3. Not yet admitted	591	321	912
	709	356	1065
Senior Colleges	265	253	518
Junior Colleges	402	419	821
Unclassified	236	439	615

B. University College.

Graduate Department	25	56	81
Senior Students	6	18	24
Junior	26	61	87
Unclassified	36	238	274

C. Divinity School.

Graduate	259	10	269
Unclassified	20	11	31
English Theological Seminary	31	11	31
Dano-Norwegian Seminary	27	0	27
Swedish Theological Seminary	37	0	37

E. Law School	76	2	78
F. Medical Students	273	29	302
G. College of Education	21	505	526

Total number of students:—

Men	2206
Women	2257
Total	4463

After visiting Chicago the writer was recommended to pay a visit to one of the Western State Universities which are mostly of recent growth and which present features novel to European ideas. The University of Michigan was chosen partly on account of its geographical position among the West Central States and partly for the fact that it is the oldest of the State Universities, its foundation dating back from 1837. Rather

curiously, public education in Michigan received its first impetus from the Indians, as in the Treaty of Fort Meigs, between the American Government and the tribes comprising the Ottawas, Pattawatomies and the Chippeways, the latter granted six sections of land for educational purposes, no doubt thinking to acquire some of the white man's power by extending the privileges of education to their own children.* The main foundation for a university was made by a land grant from the Government, and an interesting Michigan worthy—Judge Woodward by name—drew up a plan for a "Catholepistemiad or University of Michigan," which should have 13 didaxiæ (professorships), including anthropoglissica (literature), mathematics, etc. To provide the University with funds the taxes were to be increased, state lotteries were to be established and out of the proceeds fifteen per cent. was to be taken.

In 1837 the real corporate life of the University of Michigan began under the influence of John D. Pierce, superintendent of Public Instruction. There were then three departments, viz.:—

(1) Literature, Science and Art.
(2) Law.
(3) Medicine.

The tuition was to be free to students of the State, and it was decided that the fee for admission should never be more than £2. Further, it was enacted that the Board of Regents should establish "an institution for the education of women in the higher branches of knowledge." The Board of Regents were of the opinion that the fund should be expended in establishing branch colleges throughout the State, and several appear to have been started but were soon abandoned in favour of a large central institution located at Ann Arbor. Thus started auspiciously from small beginnings the University has increased in size and reputation until now, with its 3,500 students, it ranks as one of the foremost State Universities.

* From the "History of Higher Education in Michigan," by Andrew C. McLaughlin.

The famous law school which has flourished under Judges Campbell, Walker and Cooley possesses a good law library which was not incorporated with the general library until 1883, when the latter was accommodated in a separate building.

In 1866–7 the University obtained financial aid from the Legislature by the tax of $^1/_{20}$ mill on the assessed value of property within the States. Attached to this arrangement was the proviso that the regents should provide in the Medical Department at least one professorship of homœopathy. This set the Medical Department in an uproar; several professors threatened to resign, and the University proposed to erect a School of Homœopathy in some place other than at Ann Arbor, but after some further arrangement the legislature dropped their proposal for the Homœopathic College.

In 1870 the Board of Regents first definitely assented to the admission of women, and "recognised the right of every resident of Michigan to the enjoyment of the privileges afforded by the University, there being no rule in any University statute for the exclusion of any person who possesses the requisite literary and moral qualifications." In 1884 there were 170 women in attendance; in 1887–8, 284. From the point of view of social difficulties, mental or physical inequality, the experiment has been a success, and has ceased to excite any comment. No distinction is made in college discipline between women and men. They lodge with families in town; they influence the manners of the University for the better; their health has been uniformly good, and it is not apparent that in point of refinement they suffer for lack of any social advantages. The women naturally seek the classical and modern language courses, although some take the scientific course. In medicine there were last year six advanced students, thirteen third-year students, four second-year students and nine first-year students; some half-dozen are studying law, two are taking the course in pharmacy, about a dozen are studying homœopathic medicine, and the same number dentistry. Of the graduates, 14 women received the degree of M.A., eight the degree of M.D., and two graduated as Bachelors of Law.

President Angell, the present occupant of the presidential

chair at the University, has a fame equally as a college president and as a diplomat. In 1880 he was appointed Minister Plenipotentiary to China, and president of a Commission of three sent out for the purpose of making a treaty with the Chinese Government, returning to his duties at the University two years later. Again in 1887 he was appointed a Commissioner in negotiating with the Commissioners of Great Britain for the settlement of certain boundary disputes.

A similar instance of gaining the best practical men may be noted in the Department of Engineering, where Prof. Mortimer E. Cooley, of the U.S. Navy Yard, was specially appointed by the Navy Department under an Act of Congress in 1879.

As at present constituted the University of Michigan comprises seven departments, viz.:—

(1) Literature, Science and Arts.
(2) Engineering.
(3) Medicine and Surgery.
(4) Law.
(5) Pharmacy.
(6) Homœopathic Medicine.
(7) Dental Surgery.

Among the interesting possessions one notices the collections of the museums and libraries, the law library being extremely well equipped. The students reside in Ann Arbor either in lodgings or in the splendid fraternity houses which adorn the main street, and which are fitted up in a lavish manner. The new Medical School contains a fine collection of rooms, including a well-equipped bacteriological laboratory and laboratories for physiological chemistry, pathology, pharmacology, histology, physiology and anatomy. It also contains two large amphitheatres, two lecture rooms, a faculty room, etc.

To enter the medical course without conditions, the student must have taken a four years' high school course, together with two years' college work. If a student enters with a "condition" in either biology or chemistry he must remove it by attending a special course or during the Summer Session.

Recent alterations in the university include a laboratory for mechanical and electrical engineering; the new electrical laboratory contains special rooms for direct and alternating current work, a large laboratory for telegraph and telephone engineering, and research, battery room, electro-chemical laboratory, photometry and photography rooms, etc., the whole being ably organised by Professor H. S. Carhart, whose researches on standard cells have added a lustre to his name.

In the new engineering building there is a marine engineering laboratory with a tank 300 feet by 22 feet by 14 feet for testing boat models, a Glasgow man being in charge; this is the only experimental tank excepting the one in the Navy Yard at Washington. The importance of a strong marine engineering department at the University of Michigan may be judged from the position of the State among the great lakes—the tonnage of the vessels being greater than the tonnage to New York. Steamers carry produce to Chicago and Detroit from North Michigan, others carry ores from the north to Cleveland on Lake Erie *en route* for Pittsburg.

Of the present students in the University of Michigan, over two-sevenths of the number are in the Departments of Literature, Science and the Arts. The department of Law is the largest in the United States and contains nearly 900 students; the department of Engineering has 600 students; and that of Medicine 450. The homœopathic medical college which in spite of great opposition was established in 1875, has now about 80 students, including several women. What struck the writer about the University was its beautiful situation, although the University of Wisconsin at Madison is reputed to be a great rival.

It is surprising to find the comparatively small reputation of some of the State Universities. Michigan is considered one of the most promising; Wisconsin, Illinois, Minnesota, and California are among the better equipped, but in the case of a dozen others they are hardly worth the upkeep. In some cases the financial support appears to be very generous, *e.g.*, in the case of the University of California the endowment

given by Mrs. Phœbe H. Hearst has been supplemented by State funds and now includes: —

(1) The seminary and Building Fund voted by Congress.
(2) Morrill Land Act Funds.
(3) Appropriations of the State Legislature for special purposes.
(4) State University Funds of 2 cents on each 100 dollars of assessed valuation.
(5) U.S. Experiment Station Fund.
(6) Morrill College Aid Fund.

In the University of California the Hastings College of Law and the Lick Observatory have separate endowments, whilst the Institute of Art, the Medical, Dental, and Pharmaceutical Departments are supported by students' fees. With such help from the State there should be little difficulty in fulfilling the functions of a University as laid down by Jefferson, viz.: "to form the statesmen, legislators, and judges on whom public prosperity and individual happiness are so much to depend; to expound the principles of government, the laws which regulate the intercourse of nations, and a sound spirit of legislation; to harmonize and promote the interests of agriculture, manufacture, and commerce; to enlighten the youth with mathematical and physical sciences, which advance the arts and administer to the health, the sustenance and comforts of human life." *

* "Thomas Jefferson and the University of Virginia," by Herbert B. Adams.

CONCLUSION.

In attempting to sum up the impression gained by a visit as described by the writer the limitations produced by personal bias or insufficient evidence tend to make the task somewhat difficult. Nevertheless, if the visitor has taken the trouble to make a careful record of his observations he should be in a position to deduce the underlying principles which guide and control the leaders of educational thought.

The distinguishing feature of the teaching in the United States is the enthusiasm exhibited by the preceptor and the pupil. No pains are spared to make the lessons bright and interesting; the children are treated with a consideration that amounts almost to deference; the services of trained pædagogues, psychologists and physiologists are brought to bear upon the problems of mental evolution with a fastidious care that is lacking in English education. The critic might suggest that the child is being pampered and made too flabby; that the teacher aims at spectacular effects rather than the laying of a solid and lasting foundation of knowledge; yet all these defects are outweighed by the intense enthusiasm which is apparent equally in the primary schools, the high schools, the schools of technology, or the universities. Upon the idea of the personal magnetism of the teacher are based the methods largely used in teaching—the "quiz," the *seminar*, and methods of oral work seen in every variety of institution, and with this oral work there results one of the distinguishing features of the American race, that is, its readiness either in speech, in thought or in action. The English educator, on the other hand, insists strongly on the accuracy and style resulting from written work and considers the test question for all knowledge to be, "Can the pupil write it down?"

It has been suggested that at the present time America offers the spectacle of a nation which is passing through a

period of extraordinary activity—this national enthusiasm being probably only equalled in the case of Japan. Whether this idea can be accepted in a general sense remains to be seen, but it is the opinion of all competent observers that the ideals in education based upon national aspirations are certainly worthy of the highest praise. Unburdened by the inheritance of antagonistic historical ideas, the educational problem appears to present an easy solution, and owing to the rational agreements laid down at the time of formation of the American public school system the religious question has never presented any serious difficulty. Whether it is due to the freedom of thought which characterises the nation, or to the presence of direct moral teaching in schools, any attempt to distract the attention by introducing religious discussion is foredoomed to failure; in every such case the American parent has judged the question first and foremost from the view of educational efficiency. The democratic ideals in American education appear to bring results which indicate the soundness of the economic principles involved. It is recognised that expenditure of public money in training to the highest pitch the available brain power of the country is a sound investment bearing a high rate of interest. "The laws which govern the birth of genius are inscrutable. It is probable that the percentage of children of the working classes who are endowed with natural abilities of the highest order is not so great as that of the children of the people who have attained or have inherited a high position in society. But since the manual labour classes are four or five times as numerous as all the other classes put together it is not unlikely that more than half of the best natural genius of the country belongs to them; and of this a great part is fruitless for want of opportunity. There is no waste more to be condemned than the wilful negligence which allows genius that happens to be born of lowly parentage to expend itself in lowly work."* In many respects the problems which are under discussion at the present moment are similar to those occurring in English education: the

* Marshall, *Principles of Economics*, vol. i., p. 272.

widening of the elementary school curriculum to include nature study, manual training and literature; the increase in the interest taken in kindergarten work, the raising of the standard of the training colleges and the question of secondary school studies present a great complexity of ideas from different schools of educational thought. The tendency to devote more time to commercial and industrial subjects is bringing into existence a special kind of commercial school in the larger centres of population, and along with this movement there is said to be a decrease in pure culture studies, and the dropping of Latin and Greek. To counterbalance this an increasing interest is taken in the study of English, which is taught as a classic in a manner which would put to shame the methods in most English secondary schools.

With regard to the position of the teacher the lack of any great inducements will explain the scarcity of men in the profession. Taking the case of pensions for teachers we find that in America no such expenditure is available out of public school funds, but it is left for individual States to decide the question. Pension or retirement funds are authorised by the State in the cities of St. Louis, Boston, New York, Brooklyn, Buffalo, and Detroit, and temporary aid associations also exist in most of these cities; associations for voluntary benefit have been formed in Philadelphia, Brooklyn, and the District of Columbia. The dues amount to about one per cent. of the salary, the annuity varying from £50 to half the salary and the minimum time of service varying from 25 to 35 years.

The haphazard nature of the arrangement is apparent in the case of a teacher leaving to take up work in another State with a different set of pension laws. America is certainly far behind Germany in the provision of such funds since in most of the German States no payment is made by the teacher, the pension may start after 10 years' service, and the maximum amount of the retiring allowance ranges from 75 to 100 per cent. of the last salary. At first sight the salaries of American teachers compare very favourably with those obtained in English schools. The principal of a high school receives from £500 to £600; the teacher of highest rank in the same school will get

from £300 to £400; those in the lowest rank from £100 to £200. The average salary of the principal of a grammar school is £700 in New York, £400 in Baltimore, and only £300 in Washington. In such schools the chief assistants range from £150 to £470, and the junior assistants from £80 to £100. In a kindergarten school the head teacher has a salary of £120 to £160 per annum and the assistants £60 to £100. But when we take into consideration the large number of pupils in each school, the short period of service, and the high cost of living the above salaries do not appear inviting to young men when compared with the advantages of a business or professional career, and it is therefore not surprising to find that men form only 28 per cent. of the teachers in public schools. This disinclination to pay for the *personnel* of the profession stands out in marked contrast to the lavish manner in which money is expended on buildings and equipment.

Mention has been made of the large amount of elective work in the American high schools, and the resulting necessity of a large staff of specialists. Even taking into consideration the sympathetic and close relationship between the teacher and parents it does not altogether appear a wise plan to follow out. If the teacher has keenly observed the pupils' progress he is in a good position to judge of the course to be followed, whereas if left to the whim of the pupil the result is distinctly chaotic and the constant change in aim produces a corresponding loss in efficiency. To the excessive use of the elective system may possibly be traced the scrappy and unsatisfactory character of some of the science teaching in American schools. Ideas with regard to leaving examinations in secondary schools are not yet consolidated; in some of the Eastern States the University holds its own entrance examination; in the middle States a Joint Entrance Examination Board has been established, whilst in the Western States there is the plan of leaving certificates qualifying for entrance to the University. The attention paid to secondary education in America shows that the high school is rapidly becoming a powerful factor in raising the standard of higher education; already the smaller colleges are being overlapped and in cases will be rendered

superfluous. Again, the ordinary recapitulary work hitherto performed in the first year of the schools of technology and the universities has been cut out, thus paving the way for the application of a more stringent standard and the earlier specialisation in professional studies.

Mention has already been made of the tendency to shorten the college course by making the last year of the purely scientific course count as the first year of the professional course. Perhaps the most interesting part of American education is the strong utilitarian bias which it is assuming. With regard to this tendency in the universities Dr. D. S. Jordan, of the Leland Stanford Junior University, says: "As the university ideal of England is one of personal culture, that of Germany is one of personal knowledge. An educated person may lack culture—of these there are many conspicuous examples just as in England a cultured gentleman may lack exactness of knowledge on all points. In America a new ideal is arising as a result of the creative needs of our strenuous and complex times. We value education for what we can make out of it. Our idea is personal effectiveness. We care less and less for surface culture, less and less for mere education. We ask of each man not what he knows but what he can do with his knowledge. This idea of education has its dangers. It may lead us to sacrifice permanent values for temporary success. It may tend to tolerate boorishness and shallowness if they present the appearance of temporary achievement. But the fact remains that the value of success lies in its relation to human conduct. The value of knowledge lies in the use we can make of it."

Again, in the province of technical education the most characteristic feature is the manner in which the students concentrate their energies on making themselves competent to hold definite positions as captains of industry. The manual training in the high schools is supplemented with a thorough practical and theoretical training in the institutes of technology or in the universities, and in particular, the commanding influence of the American engineering trade is the result of years of careful organisation of the schools of engineering, and

the capital sunk in buildings and equipment has been paid for by a large increase in trade due to superior and more intelligent methods.

Arising out of the same ideal of usefulness we have already observed the manner in which educational institutions for the highest research in arts and science are supported by rich benefactors. The formation of the Smithsonian Institution and the new National Bureau of Standards at Washington are conspicuous examples. When we consider the excellent results which have already been attained by the Carnegie Research Fund we may well ask if there is not a tendency to disregard such work in England, where to quote Mr. H. G. Wells, "there are a few sciences lightly endowed, there are a few arts patronised with some intelligence and generosity, and for the rest there is nothing for it, for the man who wants to do these most necessary and vital things, but to hammer some at least of his precious gold into the semblance of a brass trumpet and to devote a certain proportion of his time and energy to blowing that trumpet and with an air of conscious modesty the public is pleased to consider genuine, proclaiming the value of his wares." Happily an educational renaissance appears to be approaching, bringing with it a reorganisation of the existing modes of thought, a keener examination into the practical benefits arising from a stronger educational policy, and, above all, a wider appreciation of the need for liberal endowment of the highest form of research—whether in literature, science, or art. With this bright promise for the future no true patriot will doubt the ability of the English nation to assume its rightful position as a leader in all educational progress.

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